Briefing Report on the Status of Salmon Stocks, Fisheries, and Management Programs in the Yukon River

Prepared by the Scientific
Working Group for the Delegations
from United States and Canada
concerning Yukon River Salmon

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INTRODUCTION

The purpose of this report is to brief the U.S. and Canadian delegations to the Yukon River salmon negotiations on the status of Yukon River salmon stocks, fisheries, and management programs. Fisheries conservation concerns and existing and proposed research studies are also summarized. Information presented here is not formally cited, but was extracted primarily from Annual Management Reports, Informational Leaflets, and other technical publications of the Alaska Department of Fish and Game (ADF&G), technical publications of the Department of Fisheries and Oceans (DFO), and from contracted consultant publications. This report was prepared by: Mike Henderson, Robin Harrison and Sandy Johnston of DFO and Ron Regnart, Larry Buklis, Mike Geiger and Doug McBride of ADF&G.

The Yukon River (Figures 1 and 2) is the largest river in Alaska and the Yukon Territory, and one of the largest in North America, flowing over 2,000 mi (3,200 km) from its source in British Columbia, Canada, to its mouth on the Bering Sea. It drains an area of 330,000 sq mi (855,000 sq km), approximately 60% of which is in Alaska and 40% in Canada. Water is relatively clear in lake-fed systems in the upper portion of the drainage, but becomes progressively more turbid downstream due to bank erosion, glacial silt and tannic acid stain from tributary streams.

STATUS OF FISHERIES

Description of Fisheries

Subsistence Fishery - Alaska

The subsistence salmon fishery in the Alaskan drainage is one of the largest of its kind in the state. There are approximately 10,000-15,000 Native and considerably fewer non-Native people in the area, the majority of whom reside in more than 45 small remote communities scattered throughout the drainage. Nearly all of these people are dependent to varying degrees on the fishery resources for their livelihood. Subsistence has been designated by the Alaska State Legislature (State Law 151) as the highest priority among beneficial uses of the fish and game resources. Except in areas where intensive commercial fisheries occur, the subsistence fishery is subject to relatively few restrictions in order to give preference to subsistence users.

A household survey is made annually to document subsistence catches in Alaska. The survey involves personal interviews of fishing families or the use of catch questionnaires that are mailed to fishermen after the season on which total catches are entered. One or more members of 1,064 fishing families operated approximately 790 gillnet and 170 fishwheel units for subsistence fishing purposes in 1984. Often the same fishermen take salmon for both commercial and subsistence purposes while using the same unit of gear.

Chinook and chum salmon are the most important species taken for subsistence purposes. Only small numbers of pink and coho salmon are taken. Chinook salmon are utilized almost exclusively for human consumption while chum salmon are also fed to sled dogs.

The economic value of the subsistence catch of Alaskan fishermen is difficult

to quantify. An approximate minimum value can be calculated since it is assumed that the value of subsistence caught fish is at least equal in value to the price paid to commercial fishermen for their catch. During the period 1980-84, the approximate minimum value of the Yukon River subsistence salmon harvest to Alaska fishermen is therefore estimated at 2.1 million dollars annually.

Indian Food and Domestic Fishery - Canada

Indian residents have traditionally relied heavily upon the harvest of both Yukon River chinook and chum salmon. Fishing remains an important part of Indian life. The food fishery on the Yukon River is the largest of its kind in the Yukon Territory and northern British Columbia, potentially supplying salmon to over 6,000 native residents in the area for twelve different Indian bands. Fishing sites are currently scattered throughout the Canadian portion of the drainage with primary effort focused around the following communities: Burwash, Carmacks, Dawson, Johnson's Crossing, Mayo, Minto, Old Crow, Pelly Crossing, Ross River and Teslin. The majority of the Indian food catch is dried, frozen or served fresh for home consumption with small amounts, particularly of chum salmon, dried for dog food.

Provisions for a small non-native subsistence fishery or domestic fishery have been made sporadically since 1899 in the Canadian section of the Yukon River. Domestic licenses were eliminated in 1961 and subsequently reestablished in 1974. Participants in this fishery are generally characterized by their rural frontier-type lifestyle. Domestic fishing is permitted in those areas open to commercial fishing, i.e. downstream of Tatchun Creek and in the lower portion of the Pelly and Stewart Rivers. Effort is widespread in this area and fishing gear is similar to that used in the commercial fishery, consisting primarily of gillnets with the infrequent use of fishwheels.

Commercial Fishery - Alaska

The commercial salmon fishery in Alaska dates back to 1918, although major commercial utilization of all species has only existed since 1961. Chum and chinook salmon are the primary species harvested. The relatively recent development and expansion of the commercial salmon fisheries in Alaska has enabled many area residents to obtain a cash income when other employment is often sporadic or nonexistent. Nearly all of Alaska's commercial fishermen are resident Eskimos and Athabascan Indians as are the majority of processing plant workers. The majority of the salmon catch is presently processed as a fresh/frozen product in contrast to earlier years when canning and salting were of greater importance. The economic value of the commercial catch to fishermen in Alaska is estimated at 7.2 million dollars annually (1980-84 average) and the annual wholesale value is approximately 18.3 million dollars.

The major commercial fisheries are found in the lower 150 river miles (240 km), although commercial fishing is also widely dispersed over 1,200 river miles (1,930 km) in the mainstem upper Yukon and lower Tanana Rivers. In the lower river, set and drift gillnet gear are operated, while in the upper river fishwheels and set gillnets are used to take salmon. Most fishermen operate small (16-20 ft, 5-6 m) outboard powered skiffs and do not use net rollers or powered reels of any type.

Commercial fishing effort in the lower river increased sharply during 1961-1975 when the amount of set gillnet gear doubled and drift gillnet gear tripled. With the development of the upper Yukon commercial fishery, the amount of fishwheel gear has also increased in recent years. In 1976, the Commercial Fisheries Entry Program was implemented to stabilize the amount of fishing gear. Presently about 700 gillnet (drift and set combined) permits are issued yearly for the lower Yukon area. In the upper Yukon area about 75 gillnet (set gillnets only) and 170 fishwheel permits are issued each year.

Commercial Fishery - Canada

Commercial fishing in the Canadian section of the Yukon River dates back to the late 1800's with an upsurge in activity associated with the gold rush era at the turn of the century. A Fishery Inspector was appointed in 1900 to monitor the fishery and to issue licenses. By 1903, there were 17 commercial licenses sold and 40 people engaged in the fishing industry. Most fishing took place in the vicinity of Dawson City. After the early 1920's, commercial fishing activity declined and remained at a relatively low level until recently when there was a resurgence of interest. Opening of a processing plant in Dawson in 1982 provided an additional marketing outlet and has been a major impetus for increasing catches. Commercial fishing is presently permitted in the mainstem of the Yukon River from the Canada/U.S. border to the confluence with Tatchun Creek about 20 miles (32 km) downstream from the village of Carmacks (with the exception of a 2.4 km closed area at Dawson) and in the lower sections of the Stewart and Pelly Rivers. Both set and drift gillnets as well as fishwheels are legal gear although the majority of effort is by set gillnets. The catch is marketed both for local consumption by residents and tourists and through the recently established processing plant. Fish sold to the plant are frozen and trucked to southern distributors.

Sport Fishery - Alaska

The sport fishery is limited to clearwater tributary streams. Most of the harvest occurs in the Chena and Salcha Rivers with small fisheries operating in the Anvik, Andreafsky, Nulato and Innoko River systems. Sport fishermen target primarily on chinook salmon.

Sport Fishery - Canada

An active and growing salmon sport fishery presently exists on Yukon River chinook salmon throughout Canadian portions of the drainage. Popular fishing sites include Tatchun Creek mouth, Teslin River and tributaries, Big Salmon River and tributaries of the Pelly River. Generally, development of this fishery has been limited by access. However, access has become less restrictive as the number of mining, exploration and recreational roads has increased, particularly in the past decade. There has also been a recent increase in wilderness recreation by both residents and tourists. Knowledge of the distribution of chinook salmon is therefore becoming more widespread.

Historic and Current Catch Data

Annual salmon catch data through 1984 are presented in Figures 3-10 and Appendix Tables 1-6.

Subsistence Fishery - Alaska

Subsistence salmon catches in Alaska have been documented in most years since 1918. Records indicate that in excess of one million salmon (mainly chums) were taken for subsistence in some years during the early 1900's, and even as late as 1940 (Appendix Table 1). The airplane began replacing the sled dog as a mail and supply carrier in the 1930's starting the gradual decline of the subsistence fishery. The introduction of snowmachines in the 1960's, which also replaced sled dogs as a means of transportation, further contributed to the reduction in subsistence effort and dependence. However, in recent years (1974-84) subsistence chum catches have increased moderately due to the sale of subsistence caught roe (legal during 1974-77), increased fishing effort as a result of development of the upper Yukon area commercial fishery, above average size of summer chum runs, and the increasing numbers of recreational sled dog teams.

Annual subsistence catches of chinook salmon in Alaska during 1961-84 ranged from 11,110 - 49,478 (Figure 6). During the past five years chinook catches have increased due to above average size runs (38,488 average). It is estimated that the Alaska subsistence chinook salmon catch is valued at $1,100,000 annually (1980-84 average catch of 38,488 x 22.0 lbs x $1.30/lb).

Subsistence chum salmon catches in Alaska during the 1961-1984 period have ranged from 143,948 to 481,440 (average 323,278) (Appendix Table 5). Approximately two-thirds of the catch is composed of summer chums.

Subsistence catches of summer chums in Alaska during the 1961-1984 period ranged from 107,961 - 361,080 annually (Appendix Table 5). Catches have declined since the early 1960's (312,439, 1961-65 average). Presently the summer chum salmon subsistence fishery takes about 200,000 annually (217,598, 1980-84 average). The value of the Alaska subsistence summer chum catch is estimated at $460,000 annually (1980-84 average catch of 217,598 x 7.0 lbs x $.30/lb).

Fall chum salmon are of greater importance than summer chums for subsistence use upstream of the Koyukuk River, where they compose an estimated 60-75% of the total subsistence salmon harvest. Fall chum subsistence catches in Alaska during the period 1961-1984 ranged from 44,627 to 233,347 annually (Figure 8). Annual fluctuations in the catch usually are attributed to variable run magnitudes. However, in recent years the harvest has increased in the upper Yukon area, especially upstream of the confluence of the Tanana River to the U.S.-Canada border. The recent 5 year (1980-84) average catch in Alaska is 172,335, a 51% increase compared to the previous 5 year (1975-79) average. The value of the Alaska fall chum salmon subsistence catch is estimated at $550,000 annually (1980-84 average catch of 172,335 x 8.0 lbs x $.40/lb).

Indian Food and Domestic Fishery - Canada

Prior to 1959 little was known about the magnitude of Canadian Indian food fishery catches and effort. A limited record of information does exist for the period 1909-1916 indicating total salmon harvests (species combined) at that time averaged approximately 220,000 kg (485,000 lbs). The greatest catches were from the Fort Selkirk/Pelly River area with other important fishing sites located in the Big and Little Salmon, Pelly, McQuesten/Stewart

and Hutshi River areas. Harvest data for the Indian food fishery is absent from 1917 to 1957.

From 1960 to 1964, chinook catches in the Indian food fishery averaged 7,500 but later declined to 1,000-3,000 (Appendix Table 4). An increase in catch during the 1980's raised the average for the past five years to 7,600. In recent years up to 166 Indian food fishery permits have been issued (frequently one per family group). The largest chinook catches are currently taken in the mainstem Yukon River near Carmacks and in the Pelly, Stewart and Teslin Rivers.

Fall chum catches averaged 12,000 in the Indian food fishery from 1960 to 1964 but declined to an average of 7,500 to 8,000 through the late 1960's and 1970's (Appendix Table 6). The average catch for the past five years is estimated to be 5,500. The majority of the chum catch originates from the Porcupine River at Old Crow, however significant catches are also taken from the mainstem Yukon (Minto area), Pelly and Kluane Rivers.

Little information regarding catch and effort levels in the Domestic fishery exists prior to 1961. Presumably participation and exploitation was significant during the fur farming era between 1913 and 1957. In 1932, a peak number of 35 fur-farms existed, most of which relied to some extent on salmon for animal feed. Domestic fishery catches were substantial enough at this time to instigate numerous complaints from other user groups and to prompt the recommendation for the formulation of special permits for animal feed. Although special "animal feed" licenses were never issued, the domestic fishery was eliminated in 1961. Due to resident demands, domestic licenses were reestablished in 1974. Since that time domestic catches have averaged 800 chinook and 1,700 chum salmon.

Chinook catches in the domestic fishery increased from a 1975-79 average of 610 to an average of 966 for the 1980-84 period (Appendix Table 4). Dramatic increases occurred from 1978 (421 chinook) to 1980 (3500 chinook), which lead to initiation of a license limitation scheme in 1982.

By contrast, the domestic catch of chum salmon exhibited a sporadic, yet declining trend during the past decade. For example, the 1975-79 average was 1,965 compared to 1,426 for the 1980-84 period. Peak catches occurred in 1975 and 1980 of 4,600 and 4,000 respectively (Appendix Table 6). Only 300 chum were recorded in 1983, the lowest year on record.

Commercial Fishery - Alaska

Prior to 1960, only chinook salmon were harvested commercially on a sustained basis in Alaska (Appendix Table 1). From 1918 through 1960, chinook salmon catches averaged approximately 30,000 fish annually. Under ADF&G management beginning in 1961, the annual chinook salmon harvest has ranged from 63,838 to 158,018 fish (Figure 6). The recent 5 year average annual harvest is 140,692 chinooks. The value of the chinook salmon catch to the fishermen is 4.0 million dollars (1980-84 average).

The chum salmon commercial fishery has only recently developed as a result of the decline in the subsistence fishery for summer chums, establishment of new

markets (especially in Japan) and expansion of the upper Yukon area fishery. Presently, the bulk of the commercial chum catch in Alaska is composed of summer chums.

Commercial utilization of summer chums began in 1967 as regulations were liberalized. Only 10,935 summer chums were taken commercially in 1967, but the catches increased rapidly in ensuing years (Appendix Table 5). A record catch of 1,052,266 summer chums was made in 1981. The recent 5 year average (1980-84) is 752,100 fish. The value of the summer chum salmon catch to the fishermen is 2.1 million dollars (1980-84 average).

The commercial fishery for fall chum salmon in Alaska began in the early 1960's. Commercial catches during the 1961-1984 period have ranged from 8,347 to 466,451 (Figure 8). The recent 5 year average (1980-84) harvest in Alaska is 299,000 fish. The value of the fall chum salmon catch to fishermen is 0.7 million dollars annually (1980-84 average).

Coho salmon are less abundant than fall chums and the commercial catch is dependent on the duration of the fishery for fall chums. Commercial coho catches in Alaska since 1961 have ranged from 350 to 81,940 and the recent 5 year average (1980-84) is 33,000 (Appendix Table 1). In 1984 a record 81,940 cohos were harvested in Alaska. There are indications that coho returns to the Yukon River and other western Alaska systems are increasing, and larger harvests may be warranted without impacting escapements.

A few pink and an occasional sockeye salmon are taken incidentally to the other more abundant species. Pinks are not purchased by processors due to their inferior quality (small size and advanced maturity) and sockeye are sold as "chums".

Commercial Fishery - Canada

Although information on Canadian Yukon commercial salmon catches early in this century is limited, there are records indicating annual commercial catches of up to 12,000 fish (species combined) before 1921 (Appendix Table 1). Subsequent catches declined and were generally in the 1,000-5,000 range until the late 1970's with about equal numbers of chinook and fall chum. Starting in 1979 the catch of both species increased. Commercial chinook catches peaked at 13,000 in 1983 and averaged 9,900 from 1980 to 1984, more than double the 1975 to 1979 average of 4,100 (Figure 9). Fall chum commercial catches reached a peak of 26,000 in 1983 while the 1980 to 1984 average was 16,900, more than four times the 1975 to 1979 average of 4,000 (Figure 10).

Sport Fishery - Alaska

Most documented sport fishing takes place in the Tanana River drainage by residents of the Fairbanks area. The majority of salmon harvested by the sport fishery are taken in the Salcha, Chena and Delta Clearwater Rivers. Harvest was largely undocumented until 1977, when harvest data were estimated by use of an annual postal survey. Chinook salmon harvests in the Tanana River drainage have ranged from 100 to 1,048 during the period 1977-1983, and the recent 5 year average (1979-83) harvest is 850 fish. Tanana River chum salmon harvests during 1977-1983 have ranged from 158 to 698 and the recent 5 year (1979-83) harvest is estimated at 529 fish. Coho salmon harvests in the

Tanana River drainage during 1979-1983 ranged from 25 to 147 fish and the recent 5 year average (1979-83) is estimated at 67 fish.

Sport Fishery - Canada

Unfortunately little information exists regarding catch and effort specific to the salmon sport fishery. During the past decade the total number of angling licenses for all species of fish has averaged approximately 14,500 of which roughly 50% were issued to Yukon Territory residents.

Description of Management Regimes

Alaska

The Alaska Department of Fish and Game, Division of Commercial Fisheries is the harvest management authority responsible for regulating the Yukon River subsistence and commercial salmon fisheries in Alaska. The Division of Sport Fish (ADF&G) is responsible for management of the salmon sport fishery. Regulations are promulgated by the Alaska Board of Fisheries. The Divisions of Fisheries Rehabilitation and Enhancement (F.R.E.D.), Habitat and Subsistence are also involved with the salmon resource and fishery. The Division of Fish and Wildlife Protection in the Department of Public Safety has responsibility for enforcement of fishing regulations.

The overall objective of the Yukon area research and management program is to manage the various salmon runs for optimum sustained yield. The commercial fishery is regulated on the assumption that a harvestable salmon surplus is available after providing for spawning and subsistence utilization requirements.

The various fisheries in Alaska are scattered over 1,400 river miles (2,350 km). As a result, allocation issues exist between various user groups. In order to satisfy both user group harvest allocations and conservation requirements, the commercial fishing area is divided into six districts and 10 subdistricts (Figure 1). Regulations may vary between districts and subdistricts. To illustrate the complexity of the regulations, there are 11 different weekly fishing schedules and 11 guideline harvest ranges in effect throughout the area.

As a result of the difficulty in obtaining the necessary biological information, the mixed stock and mixed species fisheries, increased effort and efficiency of the commercial fishery, allocation issues, and the need to provide for subsistence, the management of the Yukon River salmon runs must take a conservative approach.

Commercial fishing time has been greatly restricted by regulation during the past 20-25 years for purposes of conservation (Table 1). The hours available for fishing in the lower Yukon (Districts 1 and 2 combined) during the June - early July chinook salmon fishery have decreased from an average of 711 hours during 1961-1970 to an average of only 210 hours during 1981-1984. Fishing time in the lower Yukon fall chum fishery during the last two years has been reduced by an even greater rate.

Also other regulations and strategies necessary for conservation have been

implemented such as delayed season openings (to afford additional protection for early run stocks which are subject to intensive fishing effort), split fishing periods (to spread out the harvest over a greater portion of the run and to afford additional protection to smaller stocks) and mesh size restrictions (to allow optimal harvests of mixed species).

Other restrictions imposed in recent years include conservative guideline harvest ranges or quotas and in-season fishing time reductions and season closures. Approximately 20 emergency orders are issued annually for in-season regulatory changes. In-season management relies heavily on the analysis of comparative commercial and test fish catch data.

The Division of Commercial Fisheries presently assigns seven permanent staff biologists to full-time management and research activities in the Yukon River salmon fisheries. These biologists are stationed in Anchorage, Fairbanks, Bethel and Emmonak (summer only). Additionally, six full-time positions (supervisors, biometrician, programmer, administrative-clerical) in the Division's regional office support the Yukon River salmon program. Approximately 34 seasonal employees are hired by the Division each summer to assist in operating various field projects throughout the drainage. In addition, up to 14 employees in the Divisions of Sport Fish, F.R.E.D., Subsistence and Habitat are involved with Yukon River salmon activities.

Funding support for Division of Commercial Fisheries programs in the Yukon River in fiscal year 1985 total approximately $995,000 ($420,000 permanent employee salaries and benefits and $575,000 operational funds). This does not include regional office support costs or expenditures by Divisions of Sport Fish, FRED, Habitat or Subsistence which total approximately $600,000 annually.

Canada

Management of anadromous Pacific salmon stocks in Canada is a federal responsibility of the Department of Fisheries and Oceans (DFO). Yukon River fishery resources are managed by the Fraser River, Northern British Columbia and Yukon Division of DFO with administrative headquarters situated in New Westminster, British Columbia. Direct field management authority rests with the District 10 (Northern British Columbia and Yukon) office in Whitehorse, Yukon Territory.

The Department of Fisheries and Oceans currently assigns ten permanent person-years in the Whitehorse office to accommodate Yukon River fisheries responsibilities. These include a district supervisor, fishery officers, habitat technician, two biological staff members (management biologist and technician) two clerical staff members, and an equipment repairman. All of these positions include responsibilities for other fisheries throughout the entire district. The administrative positions occupied in New Westminster which oversee the District 10 activities (as well as those in the Fraser River district) include the division chief and assistant, senior management biologist, senior habitat biologist and several clerical staff members.

In the summer and fall, seasonal positions are assigned, including patrolmen (assistant fishery officers), student trainees, contract personnel, participants in job creation and other special employment projects. During

the past five years up to 25 field positions have been engaged in Yukon River salmon management programs conducting various tagging, catch and escapement monitoring, sampling and enumeration projects.

Next to conservation concerns, the Indian Food Fishery receives the highest management priority by DFO. This fishery has relatively few restrictions with little regulation of fishing time, effort and location. Although "status" Indians and elders are eligible for "Indian food fish permits," the annual issuance of these permits has been inconsistent and slow to evolve. Permit distribution is not widespread. Therefore, one must be extremely cautious in associating total effort levels with numbers of permits issued. Catch statistics have been collected utilizing a variety of methods including catch calendars, interviews and fish drying rack counts. In 1984, a comprehensive monitoring program was conducted in conjunction with several Indian bands. Seasonal staff members were hired in most of the major fishing villages to collect catch information on a regular basis.

Management of the commercial fishery has been relatively low-key with effort limitation constituting the major management tool. The maximum number of commercial licenses issued annually has been restricted to 45 since 1982 due to concerns regarding over-exploitation. Prior to that time, significant growth had occurred and interest had escalated primarily due to the development of processing and marketing facilities in the early 1980's. A "Yukon River salmon license" is issued to Canadian citizens or landed immigrants providing they possess a "personal commercial fishing license" and have previously fished in one of the previous three years. Each license is restricted to a maximum of four nets, the aggregate length of which cannot exceed 90 meters. In most years the commercial fishery has operated six days per week, although in recent years reduction in fishing time has been implemented in response to poor fish abundance. Now, fishing time in the Dawson area (the most concentrated fishing area) is open five days per week. Weekly fishery openings are monitored closely by a fishery officer and/or patrolman, who reside in the area during the fishing season.

Management practices for the domestic fishery have been similar to those employed with the commercial fishery. License limitation was initiated in 1982 with the maximum number of licenses available set at 26. Eligibility requirements include possession of a "Yukon River salmon license" and a "domestic fishing license" as well as participation in the fishery in one of the previous three years. Domestic fishermen are currently restricted to one net which cannot exceed 90 meters in length (down from the 550 m permitted prior to 1950). Fishing areas are restricted by the same boundaries in force for the commercial fishery. Catch information is collected through interview by a fishery officer and/or patrolman, and the voluntary return of monthly catch diaries.

Yukon angling licenses are issued by the government of the Yukon Territory which also assists in the enforcement of sport fishing regulations. The Territorial government has conservation officers permanently posted in most of the outlying communities. During the past five years the number of angling licenses issued annually has ranged from 10,000 to 15,000. Salmon sport fishing, especially for chinook salmon, is distributed throughout the drainage. A number of regulations have been implemented with the objective of conserving salmon. These include area/tributary closures (example Takhini

River, Tatchun Creek) and conservative catch and possession limits. The daily catch limit for salmon is as follows: five salmon of which: 1) only two may be greater than 45 cm in fork length, or 2) only one may be a chinook greater than 45 cm in fork length. Possession limit is ten salmon of which 1) only four may be greater than 45 cm in length or 2) only two may be chinook greater than 45 cm in fork length.

Escapement Index Objectives

Aerial surveys have been the primary means of obtaining information on salmon escapements in the Yukon River since several spawning areas can be covered quickly and inexpensively compared to other methods. Aerial survey counts of spawning salmon are made from slow flying aircraft at low altitudes which provide good stream visibility. Although more than one survey may be made of a spawning area during the season, only the peak count is included in this report. Since not all salmon can be counted during a single survey and some salmon are hidden from the view of the observer, the aerial survey count is regarded as an index of escapement and generally is an underestimate of total escapement. Comparisons with total escapement estimates from counting tower or weir projects in other areas indicate aerial survey counts of chinook salmon represent 30 to 70 percent of the total escapement. Aerial survey counts of chum salmon generally represent a higher percentage of the total escapement.

Aerial surveys are susceptible to several errors or biases including: 1) variability in counting skills between observers, 2) increased counting accuracy as an observer gains experience, 3) variability of counts due to weather and stream conditions, and 4) variability in the time surveys are flown in relation to the entrance (migration) and exit (mortality) of fish in the stream. However, when surveys are flown under acceptable survey conditions using standard procedures, the counts are used to compare annual fluctuations in escapements. These escapement trends yield valuable information on stock condition and the effectiveness of fishery management programs.

Other enumeration techniques may produce escapement estimates having greater precision and they include use of counting towers, weirs and hydroacoustic equipment. Projects employing these counting methods are expensive and are limited to relatively few sites. ADFG currently enumerates salmon escapements with hydroacoustic counters at four sites throughout the drainage.

Preliminary escapement index objectives have been established for several spawning populations in Alaska (Table 2). These objectives are subject to revision as additional escapement information is obtained. With the exception of an escapement objective for Anvik River summer chums based on hydroacoustic counts, the escapement index objectives are based on aerial survey counts made under acceptable survey conditions.

Most optimum escapement index objectives represent annual averages of aerial survey counts during periods when relatively large returns and escapements occurred. For example, most optimum chinook salmon escapement index objectives were based on the average of all counts made during 1978-1983 when escapements were relatively high and had rebounded from low escapements during

preceding years. Minimum escapement index objectives generally represent long-term averages.

Specific escapement objectives for salmon in the Canadian portion of the drainage have not yet been developed. Additional research and analysis of all existing information is recommended to provide a rational basis for developing these objectives which are required for management.

Reported escapements that are considerably below escapement index objectives in several streams are indicators of possible stock depletion and the need for remedial management action.

STATUS OF STOCKS

Documentation of total escapement has not been possible due to the vast size of the drainage and turbid water conditions. Most available escapement information has been obtained by aerial surveys, although ground and boat surveys, counting towers, weirs, and hydroacoustic counters have also provided escapement enumeration data. Escapement data for chinook, summer chum and fall chum salmon are presented in Appendix Tables 7-9. Since 1982, ADF&G has investigated the feasibility of obtaining total run size estimates through the use of hydroacoustic gear in the lower Yukon. Feasibility studies have been completed and it is anticipated that estimation of salmon migration past Pilot Station (river mile 122) can be initiated in 1985.

Total run estimates presented here are based on either tag and recapture studies or on the sum of documented harvests and observed escapement indices. The accuracy of tagging estimates is affected by several factors, such as tag loss, post-tagging mortality, unreported tag recoveries, and fishing gear selectivity. The use of radio tags has recently provided some insight into the significance of these factors. Estimates of run magnitude based on the sum of documented harvest and observed escapement indices are minimal estimates since only selected spawning streams are surveyed each year and survey counts are only an index of abundance.

Chinook Salmon

Chinook salmon enter the Yukon River soon after ice breakup through June and early July. The migration into the lower river is composed of fish bound for natal streams throughout the drainage. Spawning has been documented in more than 100 streams, with major populations documented in the Andreafsky, Anvik, Nulato, Chena, and Salcha Rivers in Alaska, and the Big Salmon, Little Salmon, Teslin and Nisutlin Rivers and the mainstem Yukon River in Canada (Figure 11). Spawning occurs from mid-July to early September.

The fishway at the Whitehorse dam has provided the longest continuous record of chinook salmon escapements in the watershed, from 1959 to present. Other major index areas have been monitored consistently by aerial surveys since the mid 1960's. Escapements in most streams surveyed have improved during the period 1978 to 1984, from low levels documented in the mid 1970's (Figure 12). Record escapements were documented in most of the important index streams surveyed in 1980 and 1981. The recently improved runs and escapements are attributed to previous restrictions placed on the Alaska fishery, reduced high seas interceptions, and favorable environmental conditions.

Estimates of total run size, based on tag and recovery studies, have been made sporadically since 1961 (Table 3). During the period 1966 to 1970, ADF&G estimates of total watershed run size ranged between 161,000 and 600,000 fish. The magnitude of the run upstream from Rampart was estimated by the U.S. Fish and Wildlife Service (USFWS) to be 17,000 and 22,000 fish in 1961 and 1962, respectively. Canadian estimates of run magnitudes upstream of the Canada/U.S. border were 29,000 fish in 1973, 11,000 to 37,000 in 1974, 37,000 in 1982, and 48,000 in 1983.

Yukon River chinook salmon generally return as adults between four and seven years of age. Most of these fish spend two years in freshwater and between two and five years in the marine environment. It has been found that some fish spend three years in fresh water.

The most common ages at maturity for females are 6 and 7 years, while males most commonly mature at ages 4, 5 and 6. Delayed maturity and associated increased marine mortality of females usually results in a higher proportion of males in the return. Fishwheels and small mesh gillnets are selective for the younger, smaller fish which are mostly males, while large mesh gillnets (8 1/2 in or 21.6 cm stretched mesh) are selective for older, larger fish which have a higher percentage of females. Since the majority of the harvest is taken by large mesh gillnets, a further sex ratio imbalance in favor of males can occur in the escapement.

Consistent differences in age and sex composition have been documented in spawning populations in different portions of the drainage. The proportion of older fish, primarily age 6 and 7, increases in spawning populations moving progressively upriver. This trend also translates into an increase in the proportion of females in spawning populations moving progressively upriver. Conversely, the proportion of younger fish, primarily ages 4 and 5, decreases in spawning populations moving progressively upriver. Nearly all fish that spend three years in freshwater are found in Canadian spawning populations.

In an attempt to improve management of mixed stocks, ADF&G has used scale pattern analysis to estimate the contribution of major stock groupings of Yukon River chinook salmon (termed lower, middle, and upper Yukon runs) to inriver catches. The lower and middle Yukon runs spawn in the Alaskan portion of the drainage while the upper Yukon run spawns in the Yukon Territory. Scale patterns analysis was first applied to age 5 and 6 commercial catches in District 1 in 1980 and 1981. The Alaskan contribution was estimated at 56.4% in 1980 (95% confidence range 47.0% to 66.1%) and 69.6% in 1981 (95% confidence range 7.5% to 100%). The Canadian contribution was estimated at 43.6% (range 35.1% to 51.8%) and 30.4% (range 0% to 92.3%), respectively. In 1982 and 1983, the scale patterns analysis was expanded to include the age 5 and 6 catches in District 2 (age 6 catches from District 3 were also analyzed in 1983). In 1982 and 1983, the Alaskan contribution was estimated at 46.0% (range 0% to 100%) and 57.1% (range 47.9% to 66.2%), respectively, while the Canadian contribution was estimated at 54.0% (range 0% to 100%) and 42.9% (35% to 51%), respectively. Analysis of 1984 samples is currently in progress.

The above estimates of stock composition only apply to the age 5 and 6 commercial catches in District 1 (1980-83), District 2 (1982-83), and District 3 (1983, age 6 only). These catches represent 55% to 78% of the total Alaskan

commercial catch during these years. Insufficient samples were collected to include the remaining age groups (primarily age 4 and 7) in the scale patterns analysis.

The precision of the regional stock composition estimates was influenced by the following: (1) inadequate sample of age 5 fish required pooling catch samples over several periods which increased the variance of the 1981 and 1982 estimates; and (2) adjustments to the proportional estimates between middle and upper Yukon fish in the three-way models were relatively large.

In 1982 and 1983, estimates of catch composition were made for the entire Yukon River harvest. These estimates were derived from scale patterns analysis and age composition analysis of lower Yukon commercial fisheries, and included several assumptions of stock composition of the remaining Yukon River fisheries. These assumptions included: (1) subsistence and commercial fisheries within a district have similar stock composition; (2) middle Yukon districts (3 and 4) have similar stock composition as District 2; (3) District 6 catches are composed entirely of fish of Alaskan origin; and (4) District 5 and Yukon Territory catches are composed entirely of fish of Canadian origin. In 1982 and 1983, the Alaskan contribution to the total harvest in Alaskan waters (commercial and subsistence combined) was estimated at 42.4% and 53.4%, respectively, and the Canadian contribution was estimated at 57.6% and 46.5%, respectively. Total drainage harvests were composed of 37.9% and 48.6% Alaskan fish, respectively, and 62.1% and 51.4% Canadian fish, respectively. It is not possible to estimate confidence bounds around these estimates without direct estimates of age and stock composition for each component of the harvest.

Temporal distribution of regional stocks in the lower Yukon was examined in the scale pattern analysis study. Lower Yukon stocks exhibited a somewhat later run timing, but there was no consistent difference in run timing between middle and upper river stocks.

Summer Chum Salmon

Summer and fall chum salmon represent two distinct runs in the Yukon River. Summer chums are distinguished from fall chums by: earlier run timing (early June to mid-July entry into the lower river), rapid maturation in freshwater, and smaller body size (6 to 8 lb, 2.7 to 3.6 kg). Summer chum salmon run timing overlaps with that of chinook salmon, while fall chum salmon occur coincidentally with coho salmon.

Yukon River chum salmon (both summer and fall runs) spend one winter incubating in the gravel and migrate to the Bering Sea soon after emergence in spring. Adults return at between three and six years of age, although ages 4 and 5 generally account for over 90% of the return. Sex composition is usually similar between catch and escapement.

Summer chum salmon spawn primarily in streams tributary to the lower Yukon, the Koyukuk, and the Tanana Rivers in Alaska (Figure 13). The Anvik River supports the largest spawning population, while other important tributaries include the Andreafsky, Nulato, Melozitna, Hogatza, Gisasa, and Salcha Rivers. Spawning is usually completed by early August. Escapements for most of the major stocks appear strong in recent years, exceeding escapement objectives,

although aerial survey data is often incomplete due to weather and water conditions (Figure 14). Escapement estimates based on sonar data for the Anvik River averaged 659,000 summer chum salmon for the period 1979-1984, with a peak count of 1,480,000 in 1981. Escapement estimates based on sonar data averaged 127,000 for the East Fork Andreafsky River for the period 1981-1984, with a peak count of 181,000 in 1982.

Alaskan tag and recapture estimates of total run were 3.6 and 1.6 million summer chum salmon in 1970 and 1971, respectively, while minimum estimates based on harvest and observed escapement indices ranged from 1.2 to 5.6 million fish annually during the period 1972-1981 (Table 4).

Fall Chum Salmon

Fall chum salmon are distinguished from summer chum salmon by: later run timing (mid-July to early September entry into the lower river), larger body size (7 to 9 lb, 3.2 to 4.1 kg), and robust body shape and bright silvery appearance in the lower river.

Fall chum salmon typically spawn in spring-fed upwelling areas in streams and sloughs in the upper portion of the Yukon River drainage. Major spawning areas have been identified in the Porcupine River drainage (Sheenjek River in Alaska and Fishing Branch River in Yukon Territory), the Tanana River drainage in Alaska (Toklat River, Delta River, and mainstem Tanana River upstream of Fairbanks), and in the Kluane River and mainstem Yukon River in the Yukon Territory (Figure 15). Spawning occurs from September through November. Results from a tagging study indicate that Porcupine and upper Yukon fall chums are distinguished from Tanana River fall chums by their earlier run timing and their orientation along the north bank of the Yukon River near Galena, as opposed to the south bank orientation of Tanana River fall chums.

Alaskan tag and recapture population estimates ranged from 165,000 to 676,000 fall chum salmon for various portions of the drainage from 1976 to 1980 (Table 5). Canadian tag and recapture population estimates of run magnitude upstream of the U.S./Canada border (excluding the Porcupine drainage) were 40,000 in 1973, 16,000-31,000 in 1974, 47,000 in 1982, and 118,000 in 1983. Weir counts on the Fishing Branch River ranged from 16,000 to 353,000 fall chum salmon during the period 1972-1975. Minimum annual population estimates based on documented harvests and observed escapements to selected index areas ranged from 312,000 to 927,000 fall chum salmon during the period 1974-1984 (Table 5).

Escapement indices during the period 1973-1984 indicate a serious decline in the abundance of fall chum salmon for three of the major spawning areas: the Sheenjek, Fishing Branch, and Toklat Rivers. Escapement objectives have not been met in recent years for these spawning areas, and there is reason for concern over conservation of these stocks. Average aerial survey escapement indices decreased by 28%, 54%, and 78% in the Sheenjek, Fishing Branch, and Toklat Rivers, respectively, between the period 1976-79 and the period 1980-83 (Figure 16). The Sheenjek River sonar count of 25,100 fall chum salmon in 1984 was the lowest since sonar enumeration was initiated in 1981, while the aerial survey count of 5,600 fish in the Fishing Branch River was the lowest since the early 1970's. A peak aerial survey estimate of 15,900 fish in the Toklat River in 1984 was below the escapement objective and continues the

recent trend of poor escapements to that system. Escapement to the Delta River (Tanana River system) has been relatively more stable than in the other major spawning areas. The 1984 aerial survey escapement estimate of 12,300 fall chum salmon for the Delta River exceeded the escapement objective.

Coho Salmon

Coho salmon enter the Yukon River from late July to early September. Escapement information is very limited, with comparative historical data available only from the Tanana River drainage in Alaska. Escapements appear to have been stable during the period 1973-1984, with a record high of 11,000 coho salmon observed in the Delta Clearwater River (a tributary of the Tanana River) in 1984.

Pink Salmon

Pink salmon enter the Yukon River from late June through July and spawn entirely within the Alaska portion of the drainage. The Andreafsky River supports the largest spawning population, based on limited escapement data. Returns are strong in even-numbered years.

Sockeye Salmon

Sockeye salmon are only rarely found in commercial or subsistence harvests, and no significant spawning areas have been documented to date.

FISHERY CONSERVATION CONCERNS

Habitat Issues

Placer Mining

Placer mining occurs in stream beds and banks throughout the Yukon River drainage in Alaska, Yukon Territory and British Columbia. Recent expansion in the industry has resulted in water quality problems and degradation of salmon habitat in a number of Yukon River tributaries. In Alaska this includes the Koyukuk and Tanana Rivers. In Canadian portions of the drainage placer mining occurs on tributaries to the mainstem Yukon, Stewart, White, Pelly, Teslin and Big Salmon Rivers. Major concentrations of placer activities in Canada occur in the Dawson and Mayo areas. There are currently over 800 placer mining operations in the Yukon River watershed.

Placer mining impacts fisheries by discharging sediment and heavy metals into streams and by altering stream banks with heavy equipment. In the normal operation of removing placer deposits through excavation by heavy equipment, the natural conditions of the stream are altered by the stripping of vegetation and overburden adjacent to the stream, creation of stream diversions, and altering braided and meandering stream channels. High levels of suspended and settleable solids and heavy metals in the water may be carried many miles downstream from the actual placer operation. In addition, runoff from tailings piles and settling ponds may continue to discharge sediment into the stream long after mining has ceased.

The effects of placer mining can be long lasting, blocking fish migration and

destroying or degrading spawning and rearing habitat. Extensive scientific literature and several ongoing studies in the Yukon River drainage indicate that suspended and settleable solids from placer mining can cause direct mortality to juvenile fish and eggs through suffocation, avoidance by fish of affected habitats and loss of aquatic productivity through less light penetration of turbid waters.

Highly turbid water (high levels of suspended sediment) discharged by placer mining has hindered ADF&G's ability to assess some salmon escapements. Since 1982 ADF&G has cancelled 14 aerial surveys on the Chena, Chatanika, Hogatza and Bearpaw drainages due to turbid water resulting from placer mining.

Hydroelectric Projects

Hydroelectric projects in the Yukon River drainage are currently nonexistent in Alaska and occur at a very small scale in Canada. However, future power demands in the area are difficult to project. A 1983 inventory of the potential hydroelectric development in the Yukon River drainage in Yukon Territory identified about 100 potential projects.

Fisheries impacts from hydroelectric projects can include: loss of riverine or lake habitat through flooding or the creation of a reservoir, blockage of fish migration, and flow alterations or changes in channel morphology. As a result, entire fish populations can be altered or eliminated.

Although there are no hydroelectric projects in the Alaska portion of the drainage, there is a flood control dam on the Chena River near Fairbanks which does not affect salmon migration.

An existing hydroelectric dam in Canada on the lower Mayo River prohibits chinook salmon access to upstream spawning grounds. A hydroelectric dam constructed on the main Yukon River at Whitehorse in 1957 provides adult salmon passage to upstream spawning areas by way of a fishway. However, studies by Canadian fisheries personnel have shown that substantial numbers of chinook salmon smolts are killed or injured as they pass downstream through the dam turbines.

Several sites in Canada are being considered for hydroelectric dams. In the Yukon River mainstem, a major hydroelectric dam may be developed in the Five Finger Rapids Area. The development, if built, would block chinook access to about half of the known spawning areas in the drainage. In the Pelly River sub-basin, facilities may be developed at Granite Canyon, Ross Canyon and Hoole Canyon. Chinook runs would be blocked by all three dams, and fall chum salmon runs would be blocked by the Granite Canyon dam. While these projects are considered medium-to-large scale, it is generally believed that small scale hydro projects located on a number of tributaries would not create migration barriers for as many salmon stocks.

Habitat Protection

In Alaska, water quality is regulated by the Department of Environmental Conservation (DEC) and salmon habitat alteration is regulated by the Habitat Division of ADF&G. DEC has created water quality standards which establish levels of discharge of pollutants designed to protect various uses on the

streams. In general, enforcement efforts have not adequately curtailed water pollution problems caused by placer mining.

The Habitat Division of ADF&G has authority to regulate human activities that impair spawning, rearing and migration of anadromous fish by diverting, obstructing, polluting, or changing the natural flow of water in a stream. The regulations require specific identification of anadromous waters as listed in the Catalog of Waters Important to the Spawning, Rearing or Migration of Anadromous Fish, therefore many unsurveyed streams which may contain anadromous fish are not protected. No reclamation of mined areas is currently required of the placer mining industry in Alaska.

In Canada, a new set of placer mining guidelines has been drafted jointly by the Federal Department of Indian Affairs and Northern Development, DFO, and Environment Canada. The guidelines classify streams into five categories as evaluated by habitat quality, biological sensitivity, fisheries resource values and past mining activities. The distinction between categories is based primarily on fish spawning behavior and the requirements for spawning and egg incubation. Water pollution effluent standards and placer mining technology requirements are in the process of being established for each level of sensitivity. Requirements for development plans, stream diversions and reclamation requirements are also being considered.

Alaska statutes provide for the creation of fish and game critical habitat areas which are managed for maintenance of habitat elements crucial to the species in question. Uses of adjacent uplands and waters can be controlled to prevent or minimize habitat alteration. ADF&G has nominated an area within the Toklat River (Tanana River system) that contains an important spawning population of fall chums. Most Yukon River fall chums spawn in only five or six known areas having the highest quality water and spawning gravel. Other important fall chum spawning habitats should be identified for special recognition and control.

Marine Harvest of Yukon River Salmon

This section discusses the interception of Yukon River salmon in marine fisheries outside of the Yukon River fishery. Although exact numbers are unknown, Yukon River salmon are harvested in the following fisheries: Japanese mothership and landbased high seas salmon gillnet fisheries; foreign, U.S. and joint venture groundfish trawl fisheries, and some U.S. nearshore salmon net fisheries in Alaska waters. In addition there are high seas squid gillnet fisheries by Japan, Korea and Taiwan that may be taking salmon of North American origin, but it is not known if Yukon River salmon occupy that portion of the Gulf of Alaska where the squid fishery occurs.

High Seas Salmon Gillnet Fisheries

Relatively large numbers of Yukon River salmon, primarily chinook salmon, are believed to be intercepted in the Japanese high seas salmon gillnet fisheries. The Japanese mothership fishery operates primarily in the Bering Sea, both within and outside the U.S. Fisheries Conservation Zone. The Japanese landbased fishery operates in the north Pacific Ocean south of the mothership fleet area of operation.

The combined harvest of all salmon species by these two fleets historically was in the 40-60 million catch range prior to renegotiation of the International North Pacific Fisheries convention and harvest limit reductions in the Japan/U.S.S.R. salmon agreement. The recent renegotiation of the International North Pacific Fisheries convention between Canada, Japan and the United States in 1978 resulted in time and area restrictions. The Japanese mothership fishery had to pull back ten degrees of longitude to the west and incurred additional time and area restrictions. The landbased fishery likewise pulled back ten degrees to the west (to 175° East Longitude).

These restrictions have resulted in a substantial reduction in interceptions of North American salmon, especially sockeye salmon of Bristol Bay origin. Interceptions of chinook, coho and chum salmon were also reduced. These two gillnet fisheries now catch 20-25 million salmon annually, the majority of which are of Asian origin (mostly U.S.S.R.). The Japanese pay a fee to the Soviet Union to fish Asian salmon on the high seas, but the Soviets do not allow them to fish within their fisheries conservation zone.

While the renegotiation did reduce interceptions of some North American salmon stocks, it was understood that western Alaska chinooks continued to be very vulnerable to harvest in the mothership fishery. After discussions with fishermen from western Alaska, the Japanese undertook voluntary measures to limit their chinook harvest in the mothership fleet to 110,000 fish per year from 1981-1983 and 100,000 fish per year from 1984-1986. This was done to prevent peak catches of the size that occurred in 1980 when 704,000 chinook were taken, of which over half were of western Alaskan and Canadian Yukon origin. There were problems with ensuring that the agreement was being enforced, particularly in regards to discard of chinook from catcher boats fishing outside of the U.S. Fisheries Conservation Zone. Discarded fish would still be lost to inshore harvest, but would not count against the Japanese quota. "Dropouts" from high seas gillnets (estimated to be 30% of the reported catch in one study) is another factor that may result in catches substantially larger than reported. Also, these fish are being taken as immatures weighing an average of about six pounds (2.7 kg) compared to an inshore average weight as adults of twenty pounds (9.1 kg) or more.

Information from a study recently contracted by ADF&G to the Fisheries Research Institute (FRI), University of Washington, showed that substantial numbers of chinook salmon in both the landbased and mothership fleets were of Alaska origin and, surprisingly, a large proportion were from central Alaska, as well as western Alaska (including Canadian Yukon). The origin of chinook salmon in the landbased fishery was largely unknown prior to the study. This new information indicates that an average of 188,000 and 149,000 western Alaska chinook (including Canadian Yukon) have been annually harvested during 1964-77 and 1978-83, respectively (Table 6). Since 1981 (excluding 1984 when the study was terminated), the estimated annual harvest of western Alaska chinook has been between 75,000 and 86,000 fish.

The study did not attempt to estimate the numbers of chinook salmon intercepted from each major stock (Yukon, Kuskokwim, Bristol Bay), but it did indicate that Yukon River chinook salmon were the "overwhelmingly predominant western Alaska stock" in the Bering Sea catches.

The United States and Canada have consistently maintained that directed high seas salmon fisheries should be eliminated for a variety of reasons, including the fact that stocks are fully utilized in coastal areas, stocks are broadly mixed on the high seas making management for conservation difficult, and significant wastage occurs in high seas salmon fisheries because of the harvest of immature fish and the dropout from high seas gillnets.

Foreign, Joint-Venture and U.S. Groundfish Trawl Fisheries

Foreign and joint venture fisheries operating in the Bering Sea - Aleutians area captured 23,000 to 122,000 salmon annually during 1977-1984. These fisheries operating in the Gulf of Alaska captured 7,000 to 36,000 salmon annually during 1977-1984 (Table 1). These data are based on reports from U.S. observers placed upon foreign trawlers and processing ships. The joint-ventures represent U.S. trawlers selling catches at sea to foreign processors. For all foreign and joint-venture trawl fisheries, U.S. federal regulations designate salmon as a prohibited species and any salmon caught must be returned to sea. The majority of salmon taken have been chinook salmon but the percentage of chum salmon has increased in recent year catches. Some U.S. trawlers deliver their catches to U.S. processors, but there is little information on numbers or species composition of these catches. Studies by FRI on stock origins of chinook salmon taken in the foreign groundfish fishery indicate that western Alaska (including Canadian Yukon) was the predominant stock taken.

Other Fisheries

Stock identification studies have indicated the presence of Yukon River salmon in at least two near shore salmon net fisheries operating in Alaska waters. These are the Unimak-Shumagin Islands purse seine and gillnet fishery in June and set gillnet fisheries in southern Norton Sound.

The June Unimak-Shumagin Island fishery harvests sockeye salmon primarily of Bristol Bay origin and also incidentally takes chum salmon bound for several terminal fisheries including those in western Alaska. The numbers of chums taken in the fishery are partially dependent on management of the more abundant sockeye salmon runs. Recent stock identification studies have shown that the contribution of western Alaska (including Canadian Yukon) chums in the Unimak-Shumagin Island fishery during 1983 ranged from 3% to 99% in the various time/area strata. Both Yukon River summer and fall chums are taken but exact numbers harvested annually are not known. Annual chum catches in this fishery averaged 277,000 during 1970-1979. Catches began increasing sharply after 1979 with record catches of 1,015,000 in 1982 and 756,000 in 1983. The catch in 1984 was 338,000. Coincidental with poorer than anticipated chum salmon returns to some western Alaska fisheries in 1982, several proposals to reduce the chum salmon harvest in this fishery were made to the Alaska Board of Fisheries. These proposals were rejected due, in part, to the lack of accurate stock composition information.

Previous tag and recovery studies indicate that some Yukon River chinook and chum salmon are intercepted in commercial salmon fisheries operating in southern Norton Sound located about 150 miles northwest of the Yukon River mouth. Exact numbers taken are unknown, but are probably small since the

commercial harvests where known interceptions occurred averaged only 5,500 chinook and 95,000 chum salmon during the last five years.

There is no information to indicate that Yukon River salmon occur in waters open to trolling. Trolling is prohibited in the Northern Gulf of Alaska and the Bering Sea.

River Management of Mixed Stocks and Species

Generally, fisheries that harvest mixed stocks and/or species complicate fisheries management and usually result in reduced ability to optimize yield of all components of the fishery. The cause for conservation concern generally increases in relation to the degree of mixture in the fishery. The Yukon River fisheries harvest mixed stocks usually several weeks and hundreds of miles from their spawning grounds. Salmon entering the mouth may be exposed to harvest for up to 50 days in the mainstem Yukon River. As a result, some tributary populations may be under or overharvested in relation to their actual abundance. It is currently not possible to manage most stocks in the lower river fisheries separately, and there is concern that small spawning populations may be reduced to very low levels.

Management of chinook and summer chum runs is complicated since both species exhibit similar run timing. The harvest of the more abundant summer chums in the lower river is greatly dependent on the regulations and management strategies employed toward the more intensively managed chinook salmon fishery. During the early portion of the season fishermen may use unrestricted mesh size gillnets, however, the majority of the gear operated consists of large mesh gillnets (8 1/2 in, 22 cm) which are selective for chinook salmon. Later in the season the use of only 6 in (15 cm) or smaller mesh gillnets, as announced by emergency order, redirects the fishery towards the summer chum run while providing increased protection of large chinooks, especially fecund females.

Management of the lower Yukon fall chum salmon fishery is also complicated by the concurrent run timing of coho salmon. In most years, the commercial fishery is closed by mid-August for conservation of fall chums which precludes optimizing the harvest of coho salmon.

Fall Chum Salmon Depressed Stocks

In recent years (since 1980) commercial and subsistence fall chum catches have increased sharply while escapements have substantially declined. Due to increased effort and efficiency of the fishery and problems in accurately assessing run strength in-season, there is a likelihood for overharvest. A conservative management strategy is required to allow for greater escapements and to reduce the risk of overharvesting anticipated weaker returns. Commercial harvests should at least be held to the lower half of the guideline harvest range unless a large return is apparent, and a harvestable surplus of fish is known to exist. In anticipation of a very weak return of fall chums from poor escapements of the 1982 brood year, more stringent harvest restrictions will be required in 1986.

ENHANCEMENT

Enhancement of salmon stocks in the Yukon River is presently very limited. Under the joint management arrangements of the Pacific Salmon Treaty it is an opportune time to develop clear policies to guide the future direction of enhancement in the river. One of the most important factors to consider is that, virtually throughout the fishable sections of the river, there are numerous stocks and/or species present at any given time. Fishing in these areas results in what is commonly referred to as a mixed stock fishery. When a stock is enhanced its productivity is increased compared with wild stocks with the result that a greater proportion of that stock can be caught while still providing sufficient broodstock for reproduction. This has important implications in a mixed stock fishery because a fishery targeting on a major enhanced stock may result in overfishing on the wild stocks. The net result may be no sustained increase in the average catch.

Apart from the possibility of overfishing wild stocks there are some disturbing signs of decreasing productivity of hatchery stocks in Washington and Oregon. While smolt releases are increasing adult production is declining. The reasons are unclear but it may have to do with subtle genetic changes resulting from the hatchery process. There are also indications that hatchery fish are not as productive as wild fish when they spawn in natural stream beds.

It is fortunate that the Yukon River on both sides of the border is in a relative pristine condition. Except for a few tributaries where placer mining or small scale hydroelectric projects have had an adverse effect, the productive capacity of the river for salmon is largely unimpaired. Because of this natural capacity of the system and the potential problems associated with major enhancement outlined above, the salmon stocks of the Yukon River should be continued to be managed on a wild stock basis. It is recommended that enhancement be confined to small scale mitigation projects or rehabilitation such as side channel improvement or incubation boxes designed to increase the productivity of weak stocks. Large production facilities are considered to be inappropriate and unnecessary at this time.

Alaska

A single Alaskan hatchery, operated by ADF&G, is located at Clear Air Force Station about 75 miles south of Fairbanks (Tanana River system). The objective is to facilitate research and development of aquaculture technology for chinook, coho, and chum salmon as well as grayling, sheefish and other species. Future expansion is possible provided enhancement is appropriate in existing salmon fisheries.

Plans for 1985 are to take approximately 217,000 chinook salmon eggs (from Salcha River wild stock), 1 million coho salmon eggs (local wild and hatchery stocks) and 4.5 million fall chum eggs (Delta River wild and hatchery stocks). Fry will be released in local streams and 25,000 chinook and 25,000 coho fry will be marked with coded wire tags. Expected returns this year from previous fry releases are estimated to be 700 chinooks (includes 500 captured in fisheries), 2,100 coho (800 fishery captures) and 7,800 fall chum (4,200 fishery captures).

Besides production at the hatchery, ADF&G biologists have also been monitoring the larval development, growth and downstream migration of juvenile salmon in

the Tanana River. This information is used to determine the best way in which to release salmon from the hatchery (timing of release, size at release, and numbers to be released at a particular site).

In 1979 and 1980 ADF&G biologists surveyed the area between Tanana and the mouth of the Yukon River for opportunities for salmon enhancement. Over 200 sites were examined but none had both easy access and a good water supply. Sites with better water supply were too remote to be developed.

When it became apparent that enhancement opportunities are limited by inadequate water supplies in accessible locations, work was begun on developing an experimental salmon incubator that consumed very little water. Development of this incubator has been going on for four years, during which time many improvements in water quality, reliability, and energy consumption have been made. By recirculating most of its water, the incubator's water supply has been reduced to about one-tenth of a percent of the normal amount. An inexpensive process monitor and controller regulates temperature, controls water input, and records and displays incubator data.

Canada

The only existing incubation facility for salmon in the Canadian section of the watershed is a hatchery at Whitehorse built to mitigate for losses of chinook at a dam and power generating station. The hatchery, which had its first egg take of approximately 150,000 eggs in 1984, has a capacity of 500,000 chinook eggs. About 120,000 fry from the 1984 brood year will be coded wire tagged and released in May, 1985 in Michie Creek, a natal stream located 100 km upstream of the dam.

There have been no extensive surveys to identify enhancement opportunities in the Canadian section of the watershed. However, there may be some potential for selected small projects such as stream improvement, side channel development for chums and judicious use of incubation boxes to increase production in some areas. It is anticipated that the public could play an important role in undertaking projects of this nature. Indeed, a proposal has recently been received for a project in the Whitehorse area. Reconnaissance surveys to identify suitable opportunities are recommended for the future.

FISHERIES RESEARCH PROGRAM

Previous and Ongoing Studies

Salmon harvest is documented by tabulating commercial sales receipts, by conducting interviews of subsistence and sport fishermen, and by tabulating responses to mail-in questionnaires from subsistence and sport fishermen. ADF&G uses microcomputers to process commercial sales receipts in-season, generating timely catch and effort summaries by fishing period and subdistrict. Catches are sampled at Emmonak, St. Marys, Marshall, Anvik, Galena, Nenana, Fairbanks, Rampart, Stevens Village, and other locations in the Alaskan portion of the drainage by ADF&G, and at Dawson by DFO, to obtain data on the age, sex, and size composition of the harvests.

Test fishing is conducted by ADF&G with set gillnets in the Yukon River delta, and with fishwheels in the middle portion of the drainage at Kaltag, Ruby, and

Manley Hot Springs, to provide in-season indices of abundance and run timing for chinook, chum, and coho salmon. Scale samples are collected to provide information on the age, sex, and size composition of salmon passage during closed commercial fishing periods.

Feasibility of enumerating total salmon passage by species in the mainstem lower Yukon River at Pilot Station has been investigated by ADF&G since 1982 using state of the art hydroacoustic equipment and a drift gillnet test fishing program. The equipment evaluation and sampling design phase of the study has been accomplished, and accurate in-season salmon counts are the goal of the project in 1985.

Escapement abundance is indexed for selected spawning areas throughout the drainage by aerial, ground, and boat surveys. Although the extent of coverage for any given year often depends on weather and water conditions, ADF&G usually surveys more than 30 spawning areas in both Alaska and the Yukon Territory, and DFO usually surveys up to 8 spawning areas, all within the Yukon Territory. Side-scanning sonar counters are used by ADF&G on the Andreafsky, Anvik, and Sheenjek Rivers to enumerate chum salmon escapements, while DFO visually enumerates chinook salmon through a fishway at the Whitehorse Dam. Recent escapement enumeration studies that are no longer conducted include side-scanning sonar on the Melozitna River for summer chum salmon (ADF&G), and a weir on the Fishing Branch River for fall chum salmon (DFO).

Escapements are sampled at various locations throughout the drainage to obtain data on age, sex, and size composition. These data are used to assess the quality of escapements in terms of potential egg deposition and anticipated productivity, and also to evaluate the age, sex, and size selectivity of the various fisheries and gear types. Salmon were sampled from 15 spawning populations by ADF&G in 1984, 5 of which were in the Yukon Territory. Chinook salmon used for a hatchery egg-take at the Whitehorse Dam and chum salmon from the Fishing Branch, Kluane and main stem Yukon Rivers were sampled for age-sex-size data by DFO in 1984.

Feasibility of identifying region of origin of chinook salmon in mixed-stock commercial catches in the lower river was examined by ADF&G in 1980 and 1981 using scale patterns analysis. The method has proven successful, and the program has been expanded and continued. Escapement scale samples were collected from the lower and middle portions of the Yukon River drainage (in Alaska), and from the upper portion of the drainage (in Canada), and the patterns analyzed and compared to those of scale samples from mixed-stock catches. Catches were then apportioned to region of origin. Estimates of chinook salmon stock composition for the entire drainage have been computed since 1982. Electrophoretic sampling of chum salmon stocks was conducted by DFO in 1984 in the Fishing Branch, main stem Yukon and Kluane Rivers. Expanded compilation of baseline genetic information of discrete stocks may allow stock separation based on these data.

During the mid-1970's, DFO conducted stream and lake inventories of fish distribution and corresponding habitat characteristics in the major sub-basins. Additional aquatic inventories were conducted during the 1980's by DFO (Stewart River) and the Department of Renewable Resources of the Yukon Territorial Government (southern lakes, MacMillan Pass and Mayo areas).

Tag and recapture studies have been conducted by ADF&G, DFO and USFWS to assess migration routes, run timing, and swimming speeds of various stock groupings, and to estimate total population abundance and fishery exploitation rates. The Yukon Basin Study conducted by DFO from 1981-84 included both radio telemetry and spaghetti-tagging of adult chinook and chum salmon. These studies provided valuable insight into migratory behavior and timing of specific stocks as well as confirming the extent and signifigance of main stem spawning. Results from the radio telemetry program were further used to qualify the population estimates generated through the tag and recovery program.

The distribution and migration timing of juvenile salmon has been obtained in studies conducted by DFO (mainstem upper Yukon River and Minto area), ADF&G (mainstem lower Yukon, Salcha and Delta Rivers) and USFWS (mainstem middle Yukon and Chena Rivers).

Several environmental impact studies by DFO, ADF&G, University of Alaska and the private sector have yielded information on the effects of placer mining and other industrial activities on fishery resources. Some of these studies have contributed site specific information on the life history, distribution and relative abundance of salmon.

A university professor completed a 3-year contract for ADF&G in 1983 to develop a computer model of chinook salmon run timing and abundance in the Yukon River delta. Historical commercial harvest data and environmental factors were included in the model, which was designed to assist fishery managers with in-season assessment of run strength based on run timing patterns. ADF&G has also funded FRI to study the stock composition of chinook salmon taken in the Japanese high seas gillnet interception fishery, using scale patterns analysis.

Proposed Studies

The following research studies have been identified by both ADF&G and DFO as necessary for the effective management and conservation of the Yukon River salmon stocks (not in order of priority):

1) Improve documentation of subsistence, Indian food, and domestic fishery harvests.

2) Expand both catch and escapement sampling of chinook, chum, and coho salmon for more comprehensive assessments of the age, sex, and size composition of returns.

3) Identify fall chum salmon stocks and estimate abundance for: a) the entire drainage by tagging in the Yukon River delta, and b) the Canadian portion of the drainage by tagging near the U.S./Canada border. Examine alternative stock identification techniques, including scale patterns analysis and electrophoresis.

4) Further develop and refine estimates of chinook salmon abundance by tagging or mainstem hydroacoustic assessment, and of fisheries exploitation of major stocks by expanding the catch sampling and scale patterns analysis program.

5) Improve chinook, fall chum, and coho salmon tributary escapement estimates by: a) expanding aerial and ground survey coverage of spawning tributaries in terms of both the number of streams surveyed and the number of surveys conducted for each stream each year, and b) intensively studying selected index streams using weirs, counting towers, or hydroacoustic counters, and compare results to survey estimates to obtain survey adjustment factors.

6) Develop escapement objectives for the major spawning tributaries to better assess stock status and adjust fisheries management strategies.

7) Apply coded-wire tags to juvenile salmon released from hatcheries at Whitehorse, Yukon Territory, and Clear, Alaska. Assess contribution of hatchery stocks to return and harvest through a tag recovery program.

8) Determine juvenile salmon distribution and abundance for selected spawning tributaries. Attempt to develop an adult return forecast based on these data.

9) Define spawning and rearing habitat requirements for each salmon species, and inventory these critical habitats, especially in areas with a high potential for resource development.

10) Determine river of origin of chum salmon harvested in the Unimak-Shumagin Islands domestic fisheries by tag and recovery and/or scale patterns analysis.

11) Estimate interception of chinook salmon of Yukon River origin in high seas foreign fisheries using scale patterns or electrophoretic analysis.

1985 RUN OUTLOOK

Chinook Salmon

In most years age 6 is the dominant age class, however, 5 and 7-year old fish also contribute to the run. The 1979 brood year run (6-year-olds in 1985) was judged above average in abundance as indicated by comparative catch and escapement data. The return of 5-year olds (1980 brood year) is expected to be significant based on above average run strength in 1980. Seven-year olds may contribute significantly to the run in 1985 based on the average to above average return of 6-year-olds in 1984. In summary, based on evaluation of brood year run size data, and assuming average survival, it is expected that the 1985 Yukon River chinook salmon run will be average to above average in magnitude. The expected commercial harvest in Alaska is expected to total 90,000-120,000 fish if run strength is judged average or better.

Summer Chum Salmon

Normally Yukon River summer chum salmon runs are primarily composed of 4-year-old fish, although in some years 5-year-old fish are present in large numbers. The return of 4-year olds in 1985 will be dependent on the strength of the 1981 brood year and the survival of the resulting cohort. Based on

available catch and escapement data, the magnitude of the 1981 summer chum salmon run was considered exceptionally strong. The return of 4-year-olds in 1985 is expected to be above average in magnitude. The return of 5-year-olds in 1985 is expected to be significant based on the strong return of 4-year-olds in 1984. In summary, the magnitude of the Yukon River summer chum salmon run in 1985 is expected to be above average in magnitude. The commercial harvest in Alaska is expected to total 600,000-1,200,000 fish.

Fall Chum Salmon

Similar to the summer run, the majority of the fall chum returning each year are 4-year-old fish. Based on comparative catch and escapement information, the 1981 brood year (4-year-olds) was generally considered above average in magnitude. The returns of 5-year-olds (1980 brood year) is not expected to be significant because of the below average to average return of 4-year-olds in 1984. In summary, the 1985 Yukon River fall chum salmon run is expected to be average to above average in magnitude. The expected commercial harvest in Alaska should approximate 145,500-233,000 fish, the lower end of the guideline harvest range for the entire river.

Coho Salmon

Four-year-old fish (1981 brood year) are the dominant age class. Adequate escapement information for coho salmon is lacking, but surveys in the Tanana River system indicated above average escapements in 1981. The return in 1985 is expected to be of similar magnitude. The coho salmon commercial catch is expected to total 10,000-30,000 fish, depending on the amount of fishing effort directed on the fall chum run and the duration of the fishing season.

1985 MANAGEMENT PLANS

Lower Yukon Fisheries - Alaska

Chinook and Summer Chum Salmon

Prior to the opening of the commercial fishing season in the lower Yukon (Districts 1-3), chinook salmon subsistence and test fishing catches will be closely monitored as indicators of run timing and abundance. Since 1981, the fishing season has been delayed for 7-10 days while the chinook run is in progress. This action is intended to increase escapement of early run fish, which are subject to intensive exploitation throughout the entire drainage, to the upper portion of the drainage. Fishing seasons in each district are opened by emergency order on a staggered basis: District 1, followed by District 2 and then District 3.

Weekly commercial fishing periods are established by emergency order and usually consists of two 24 hour periods. Fishing time may be altered by emergency order depending on in-season assessments of run magnitude.

During the commercial fishing season subsistence fishing may occur only during commercial fishing periods which provides for escapement requirements and facilitates fisheries enforcement. Thus, reductions in commercial fishing time made for conservation purposes in recent years also impact subsistence fishing. As a result, special subsistence fishing periods are now provided every other weekend through July 19.

Regulations provide for a 60,000 to 120,000 chinook salmon guideline commercial harvest range for Districts 1 and 2 combined which includes incidental chinook salmon catches taken with 6 in (15 cm) or smaller mesh gillnets late in the run.

The midpoint of the guideline harvest range (90,000) should be the expected catch if the run is of average magnitude. The upper end of the guideline harvest range (120,000) should not be exceeded unless a very large run can be substantiated. A 1,800-2,200 chinook salmon guideline harvest range is in effect for District 3.

A key regulation for providing appropriate separate commercial harvests of chinook and summer chum salmon, which occur simultaneously, is the date when gillnets of maximum 6 in (15 cm) stretched mesh must be used. This gillnet mesh requirement is accomplished by emergency order during late June through early July. The smaller mesh gillnet fishery has been effective in reducing the chinook catch during the late run, including that of large fecund females, and increasing the harvest of the more abundant summer chums.

If a very large run of summer chum salmon is evident early in the season as indicated by test fishing and commercial catches (taken with unrestricted mesh size gillnets), then the use of only 6 in (15 cm) maximum mesh size gillnets during special fishing periods early in the season may be implemented if chinook salmon escapement requirements are not jeopardized.

Fall Chum and Coho Salmon

In response to poor fall chum escapements documented in recent years, difficulties in assessing in-season run strength and increasing fishing effort and efficiency of the fleet, the Alaska Board of Fisheries in 1983 adopted several important regulatory restrictions. These restrictions were intended to reduce and distribute the fall chum harvest throughout the run.

An approximate 7-10 day closure of the commercial fishing season for the lower Yukon area will be implemented in mid-to late July during the early portion of the fall chum run to provide protection for early run stocks. The season closure will be implemented by emergency order on a staggered basis for each district.

Based on emergency order authority, a fishing schedule of two 24-hour periods per week will be allowed in the lower portion of District 1 to allow additional fishing time for set net fishermen, who are affected by tides. In other areas of District 1 and in District 2, both set and drift gillnets may be operated for two 12- hour fishing periods per week during the commercial fishing season. A daylight fishing schedule for the 12 hour periods (e.g. 6 a.m. to 6 p.m.) will be established for fishermen safety. In District 3 the fishing schedule will be two 24-hour periods per week.

The reduced commercial fishing schedule for the fall chum salmon fishery also affects the subsistence fishery since fishing time for both fisheries is coincidental. A special fishing period of 24 hours for subsistence-only will be allowed each weekend in the upper portion of District 1 and in District 2 during the fall chum commercial fishing season.

The Alaska Board of Fisheries in 1983 directed ADF&G to target toward the lower end of the guideline harvest range unless the run is of very large magnitude. If the fall chum run is of below average to average magnitude, the harvest should approximate 120,000-170,000 fish. If the fall chum run is exceptionally large, then a greater harvest may be taken, but the upper end of the guideline harvest range (220,000 fish) should not be exceeded.

Reopening of the lower Yukon area commercial fishing season for coho salmon would be allowed only if it is apparent the fall chum salmon run is above average in magnitude. This special coho salmon fishing season would occur in late August and extend into early September. It will be considered experimental and contingent on an above average coho run occurring coupled with a small incidental catch of late fall chums.

Upper Yukon Fisheries - Alaska

Chinook and Summer Chum Salmon

The upper Yukon area commercial chinook salmon fishery is primarily regulated by a combined 5,550-6,950 fish guideline harvest range which is apportioned to Districts 4, 5 and 6. Once the chinook salmon guideline harvest range is taken the fishing season in each district is usually closed until the fall season.

Commercial and subsistence fishing is allowed for two 48-hour fishing periods per week in most of the upper Yukon area. These split fishing periods help spread the harvest over a greater portion of the run and afford additional protection to smaller stocks which are more susceptible to overharvest than the larger, more productive stocks.

If the chinook salmon guideline harvest range is taken before July 10 in District 4, the commercial fishing season will be closed by emergency order. The season would be reopened during the period July 10-31 to fishing with gillnets of 6 in (15 cm) or smaller mesh and fishwheels. This action would minimize additional harvest of large chinook salmon and still allow continued commercial fishing for the more abundant summer chums.

If subsistence catches of summer chums after the chinook salmon season closure are above average in magnitude, a reopening of the early commercial season in District 6 will be considered.

Fall Chum and Coho Salmon

The commercial salmon fisheries are regulated by scheduled weekly fishing periods and guideline harvest ranges (25,500-100,500 fall chums and cohos combined for Districts 4, 5, and 6). ADF&G will manage the fishery for harvests approaching the lower end of the guideline harvest range in each district. A larger harvest may be allowed if the run is exceptionally strong, but in no case will the guideline harvest range in any district be exceeded.

In Districts 5 and 6 the opening of the fall season will be delayed until the strength of the fall chum run has been assessed and the run has been

distributed throughout the major fishing areas of both districts. This strategy has been endorsed by the Alaska Board of Fisheries and should result in better balanced harvests and escapements throughout the districts.

Subsistence Salmon Fishery Management Plan, Subdistrict C of District 6

This management plan was adopted by the Alaska Board of Fisheries to insure adequate subsistence salmon harvests and escapements in that portion of the Tanana River drainage upstream of the Wood River. Subsistence salmon harvest quotas in the subdistrict are 750 chinook and 5,000 chum salmon taken through August 15, and 5,200 chum and coho salmon combined taken after August 15. When the various salmon quotas have been taken the subsistence salmon fishing season in this subdistrict will close. The commercial fishing season in the subdistrict will be closed by emergency order when the subsistence quotas have been taken.

Canada

The 1985 management plan for the Canadian portion of the Yukon River is substantially the same as in the recent past (see above; Description of Management Regimes - Canada).

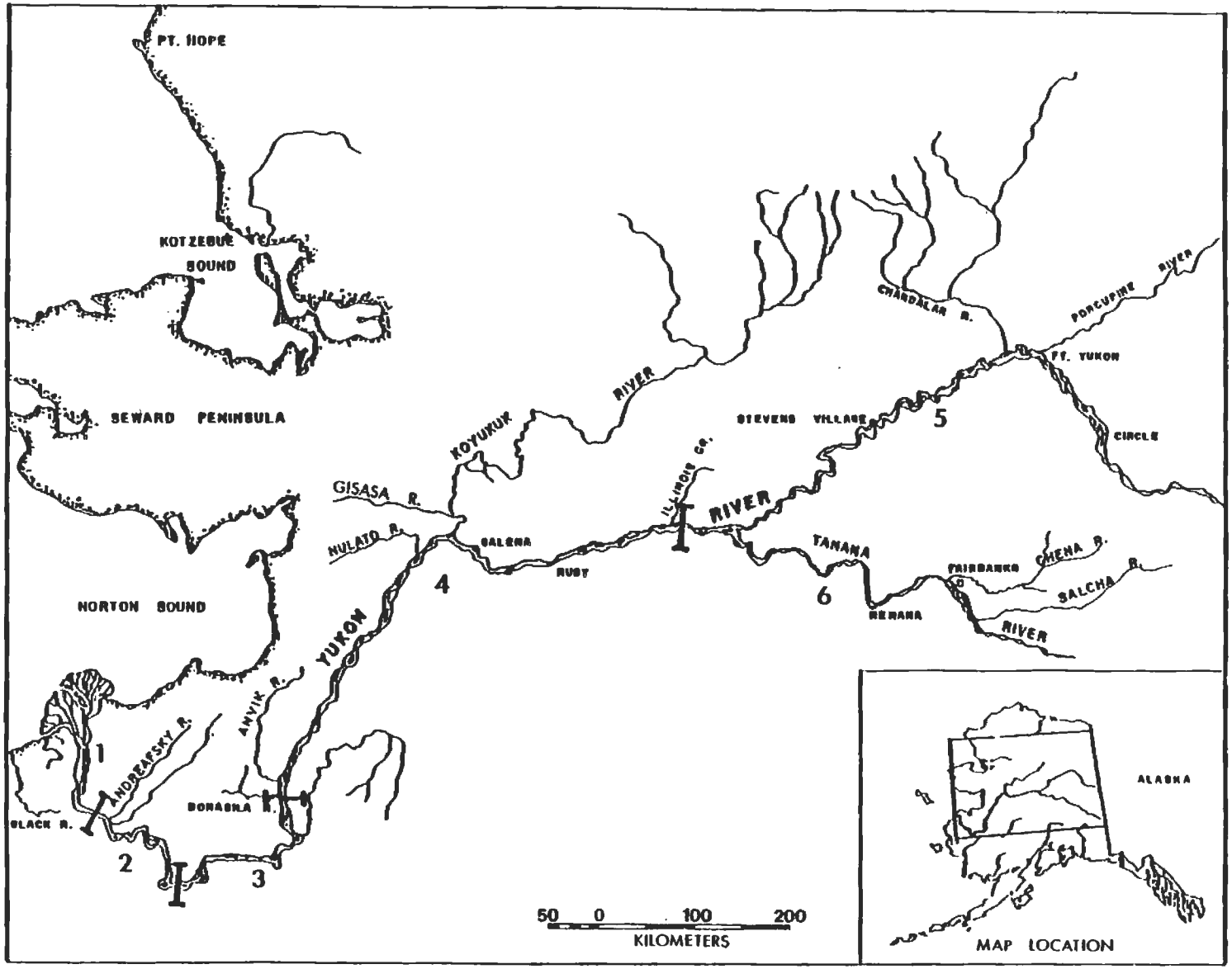


Figure 1. Alaskan portion of the Yukon River showing the Alaska regulatory districts.

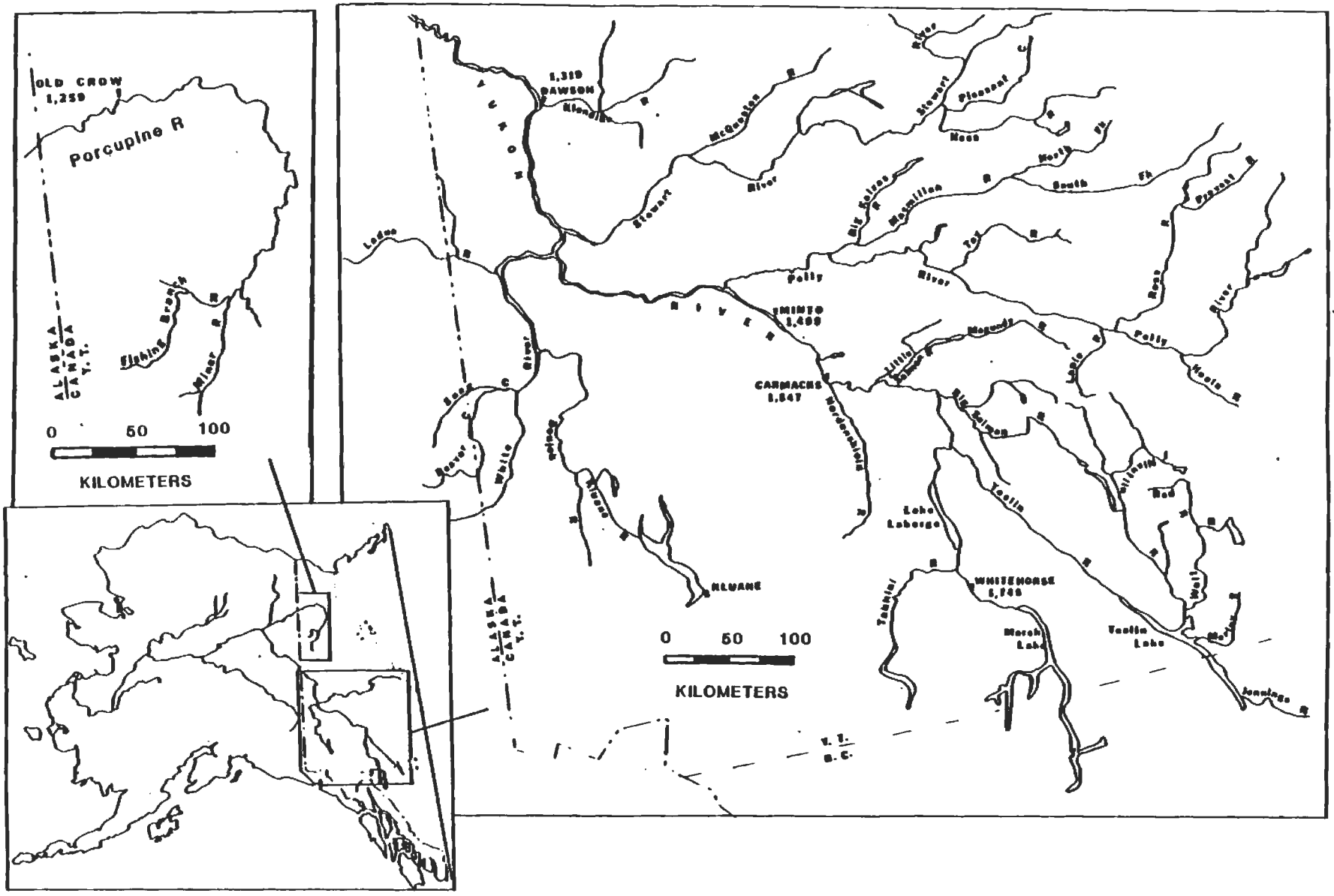


Figure 2. Canadian portion of the Yukon River drainage.

FIGURE 3 .

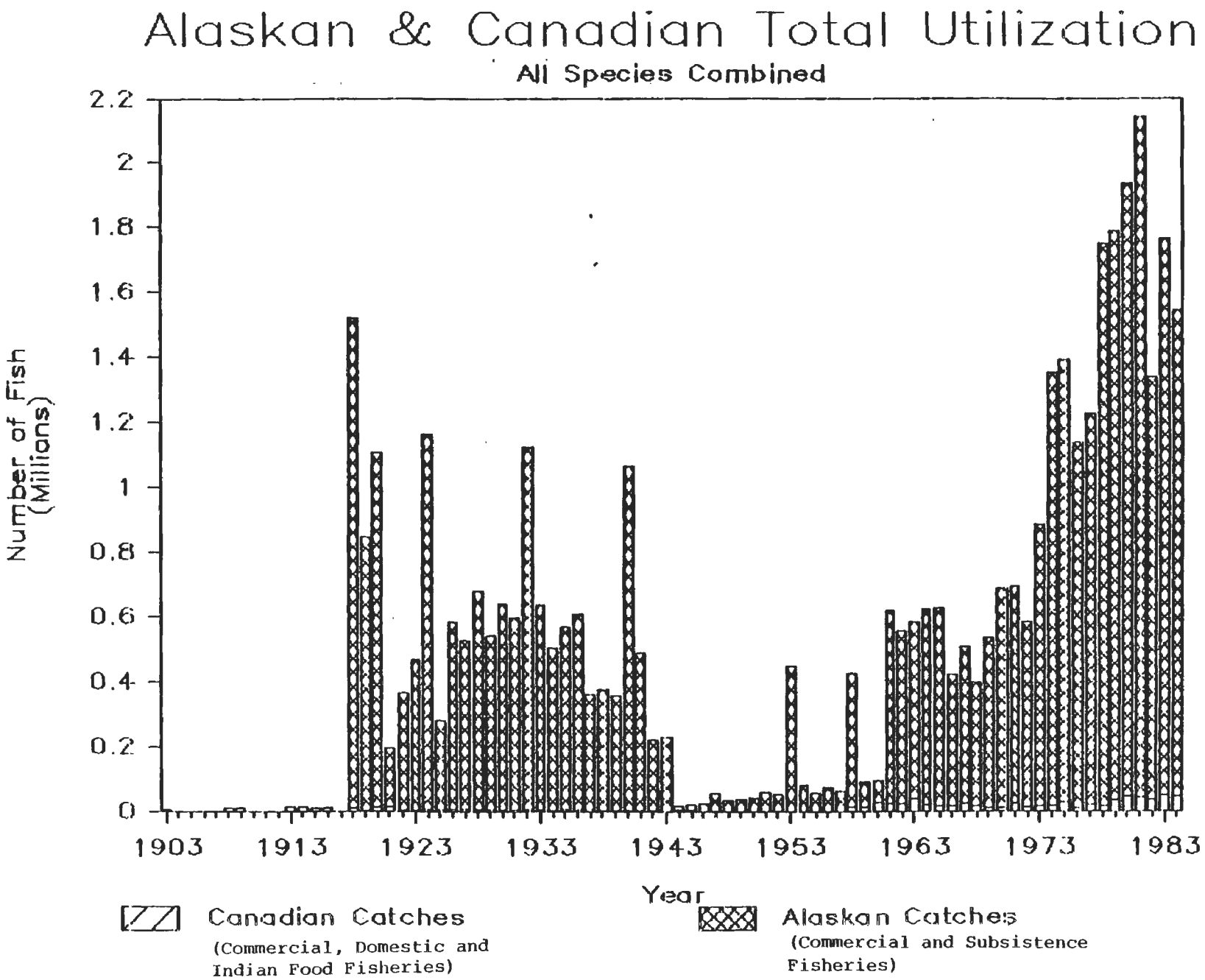


FIGURE 4 .

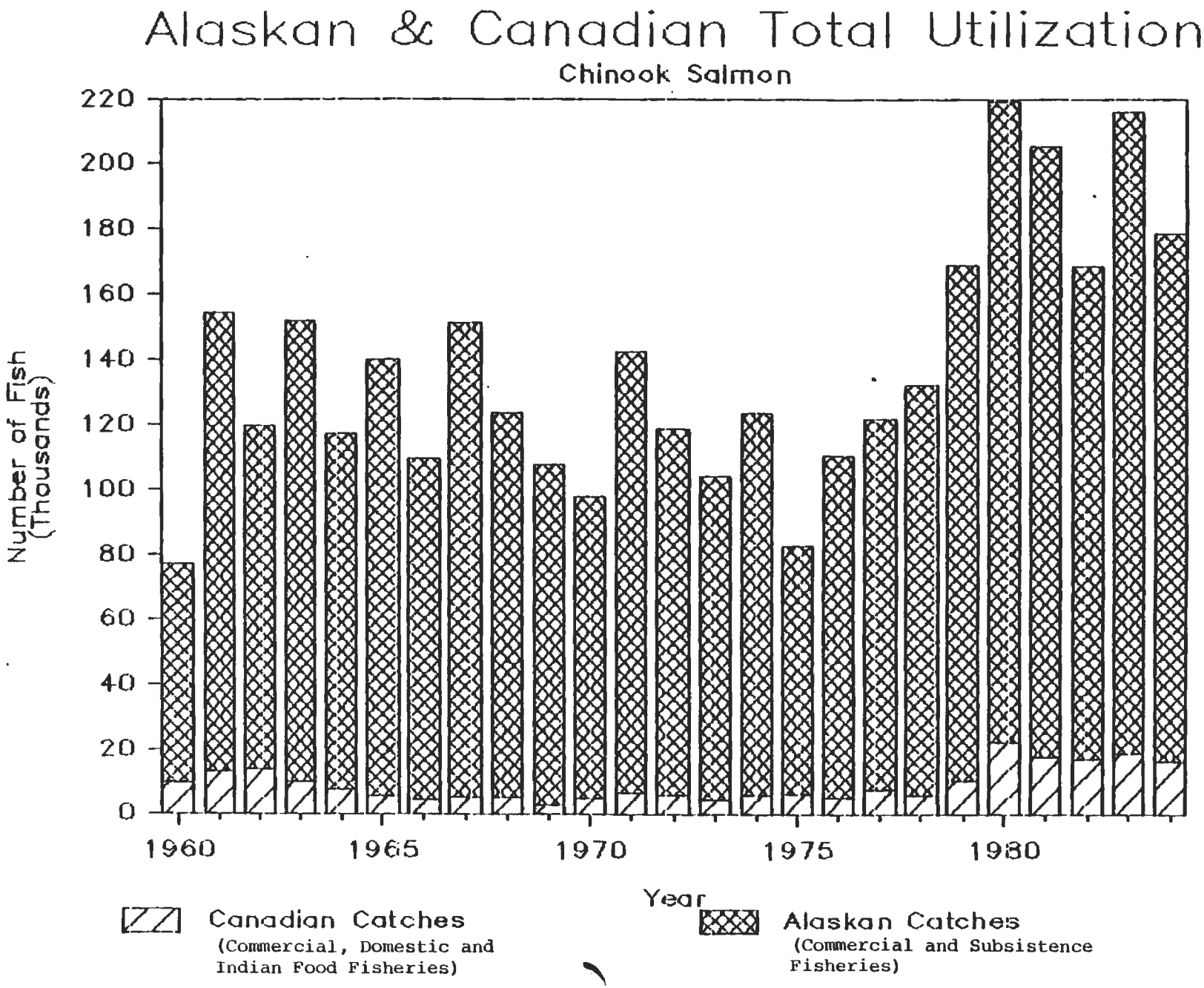


FIGURE 5 .

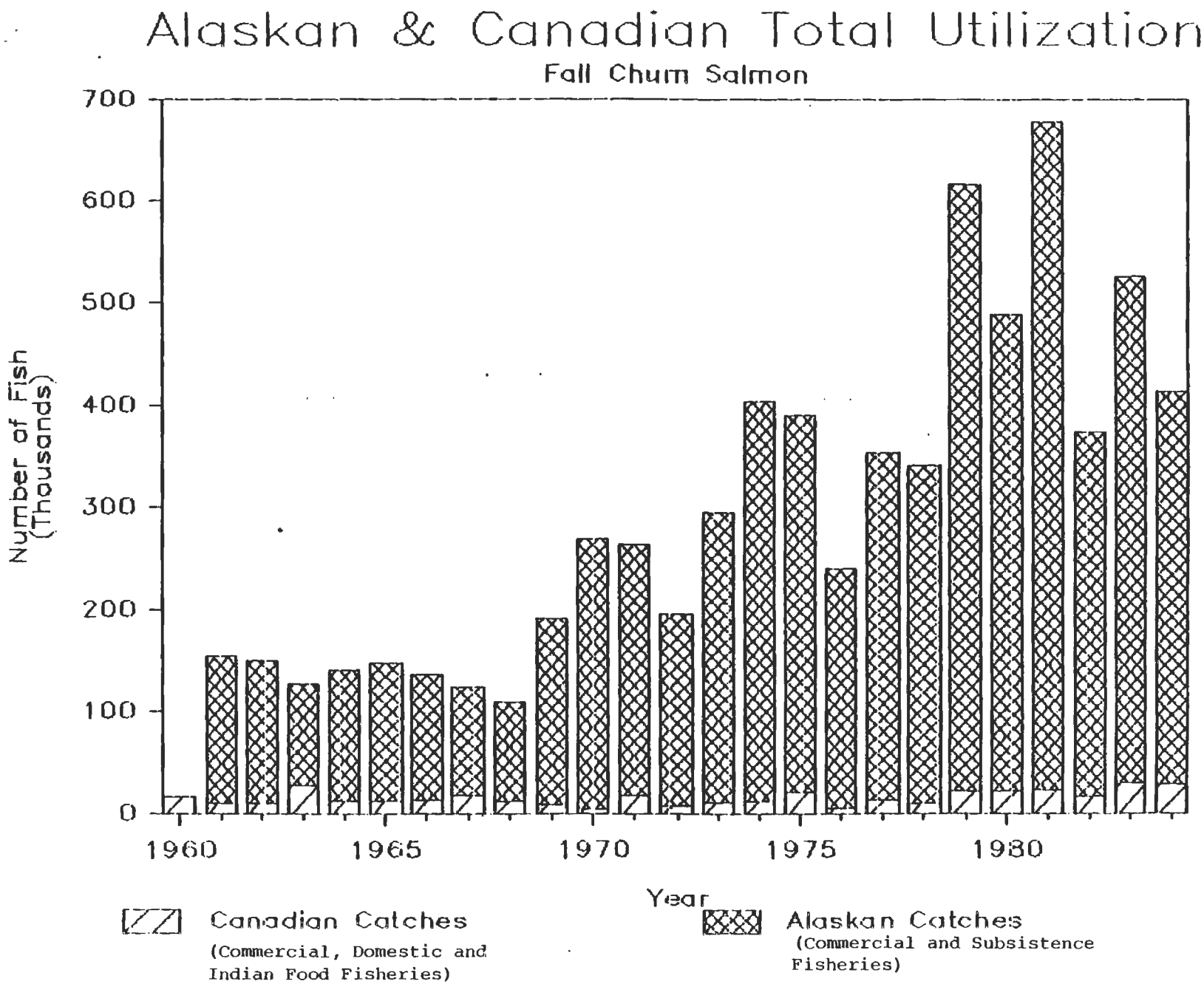


FIGURE 6 .

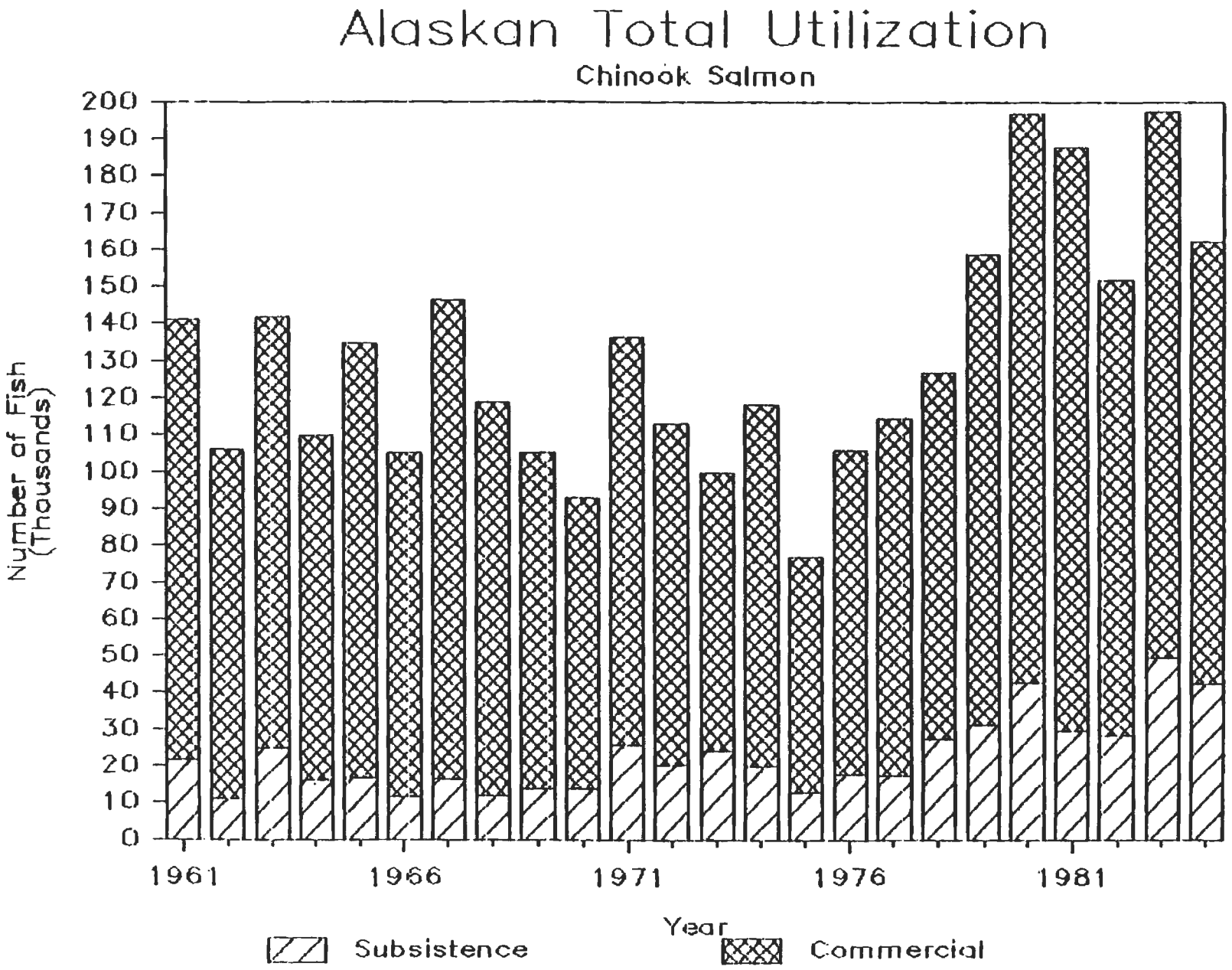
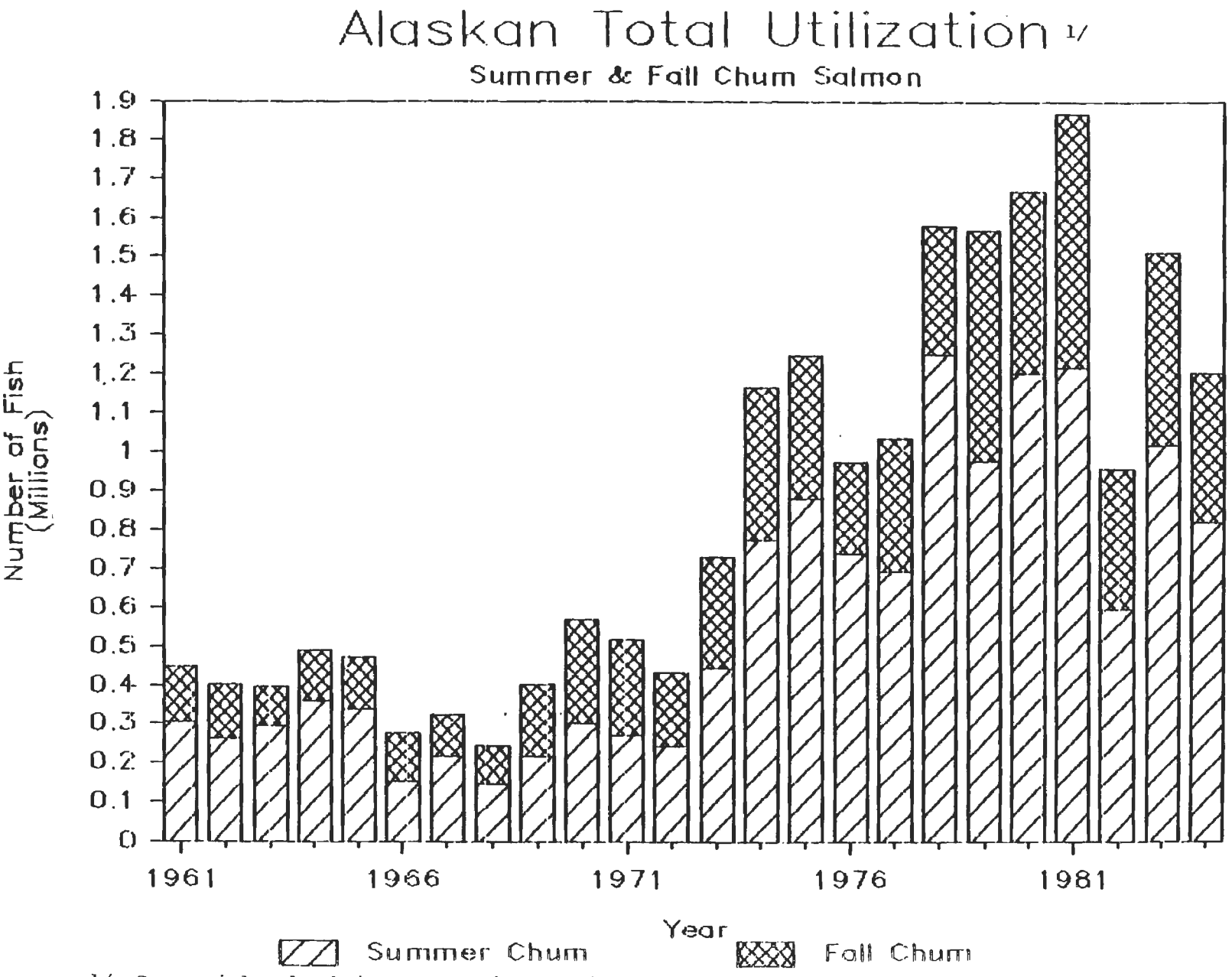


FIGURE 7 .



1/ Commercial and subsistence catches combined.

FIGURE 8 .

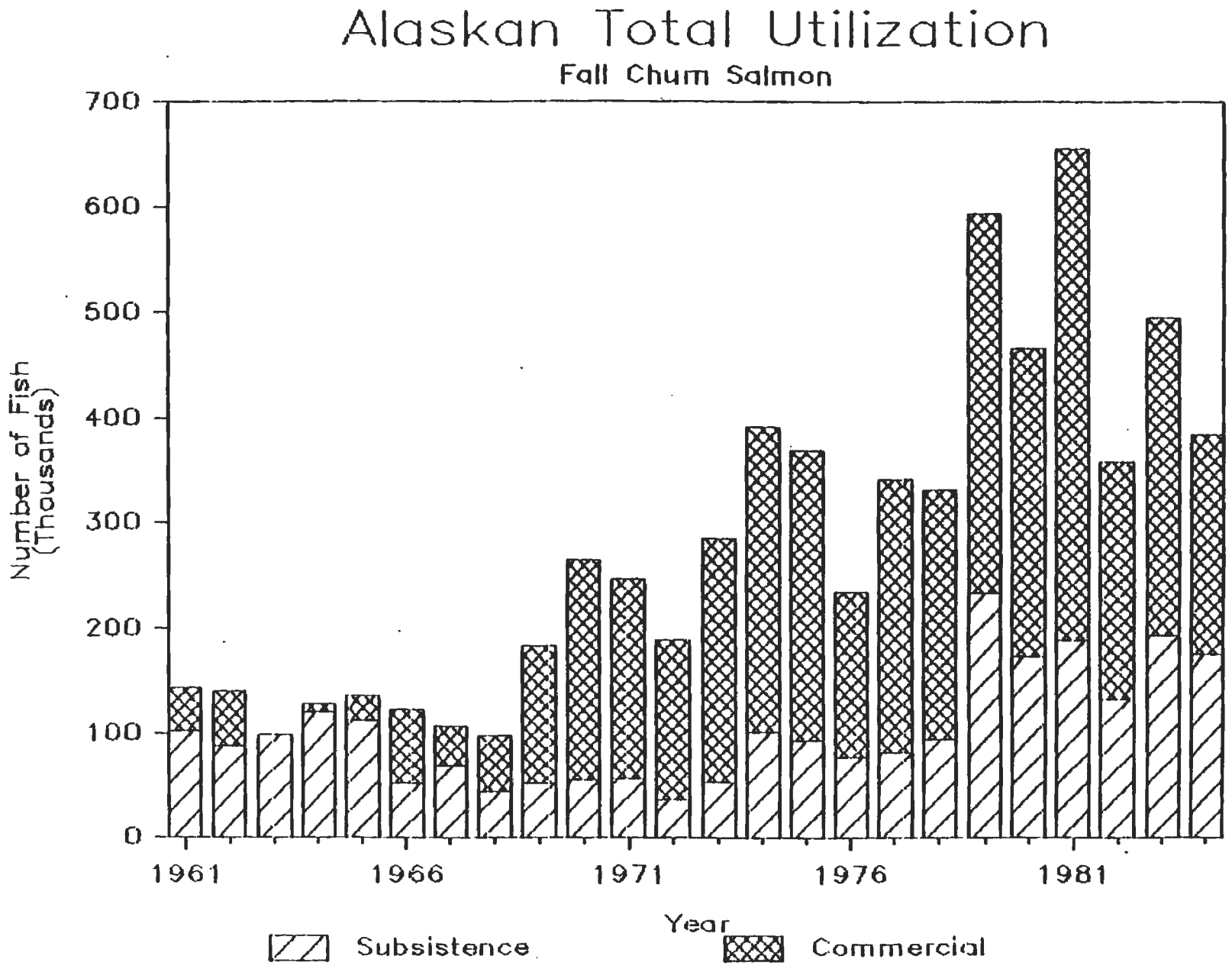


FIGURE 9 .

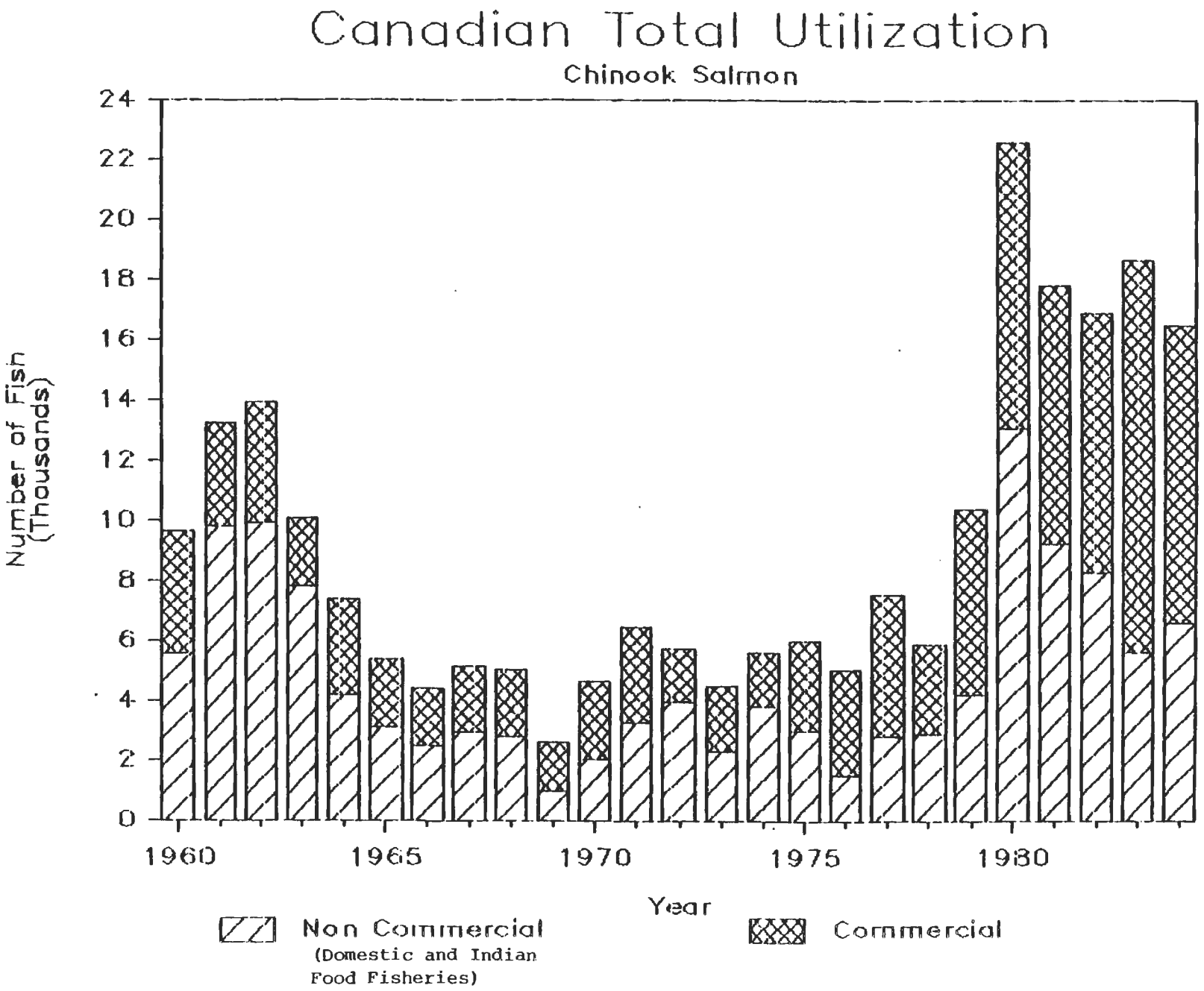
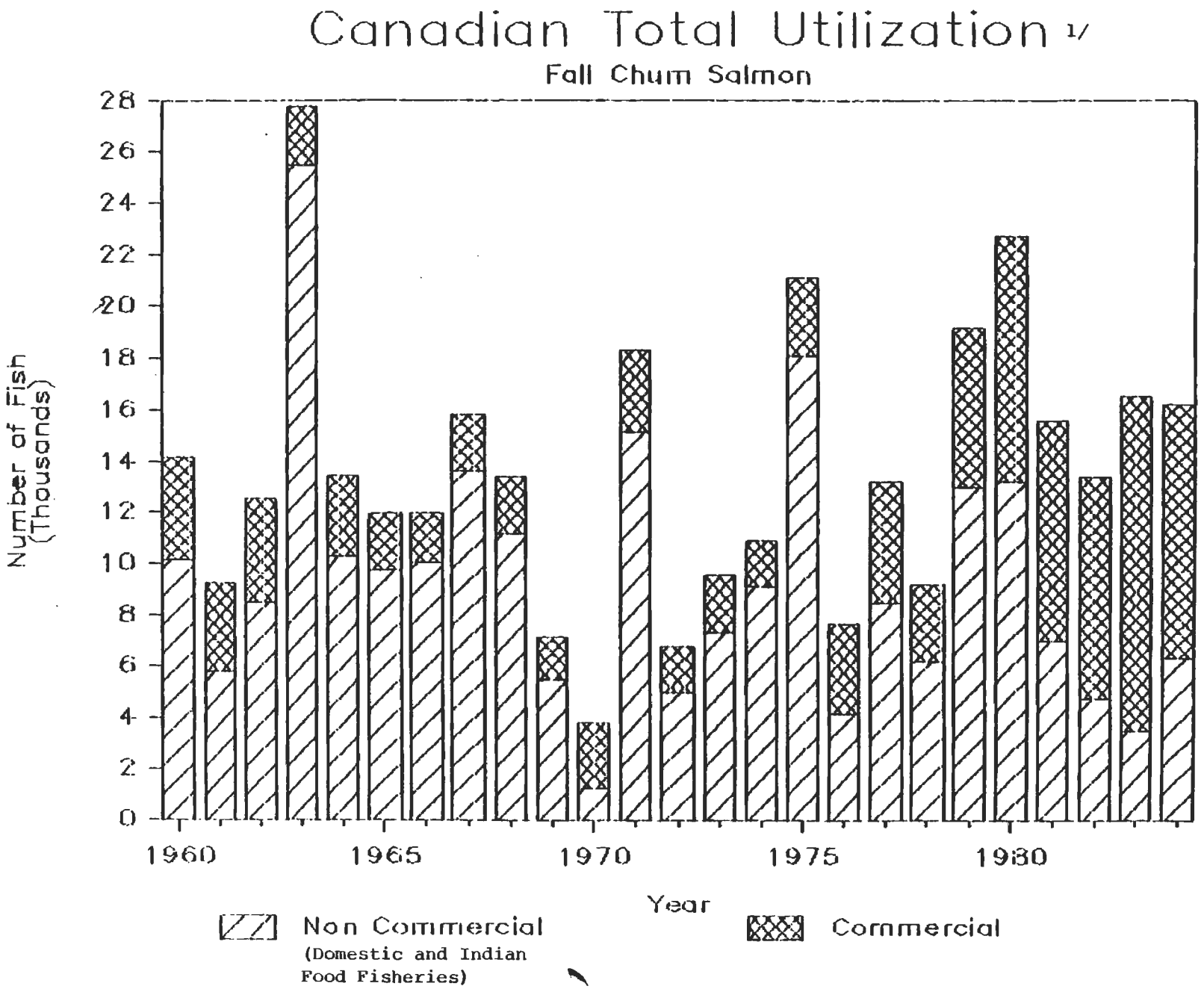


FIGURE 10.



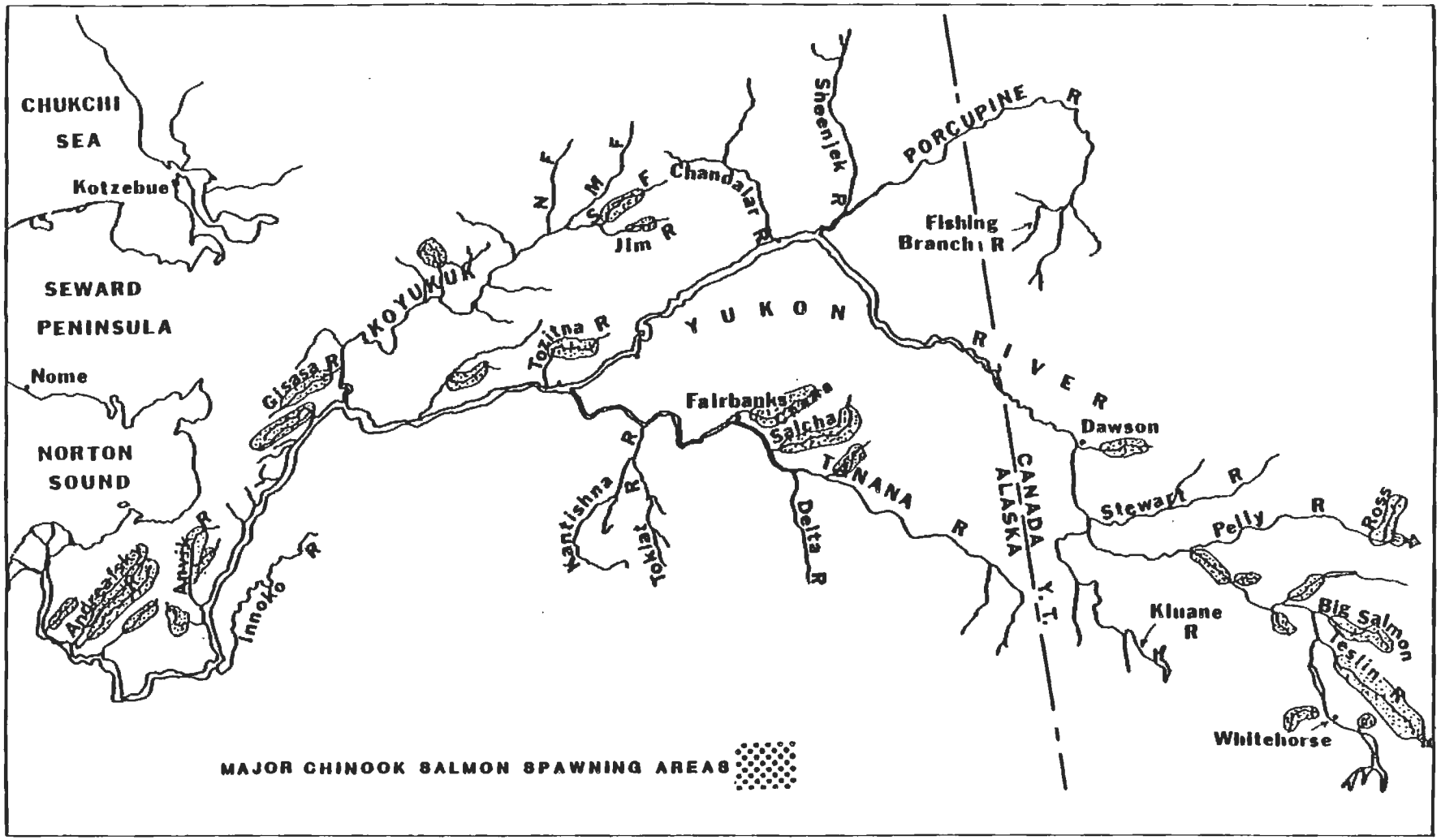


Figure 11. Chinook salmon spawning areas in the Yukon River drainage. (Not drawn to scale.)

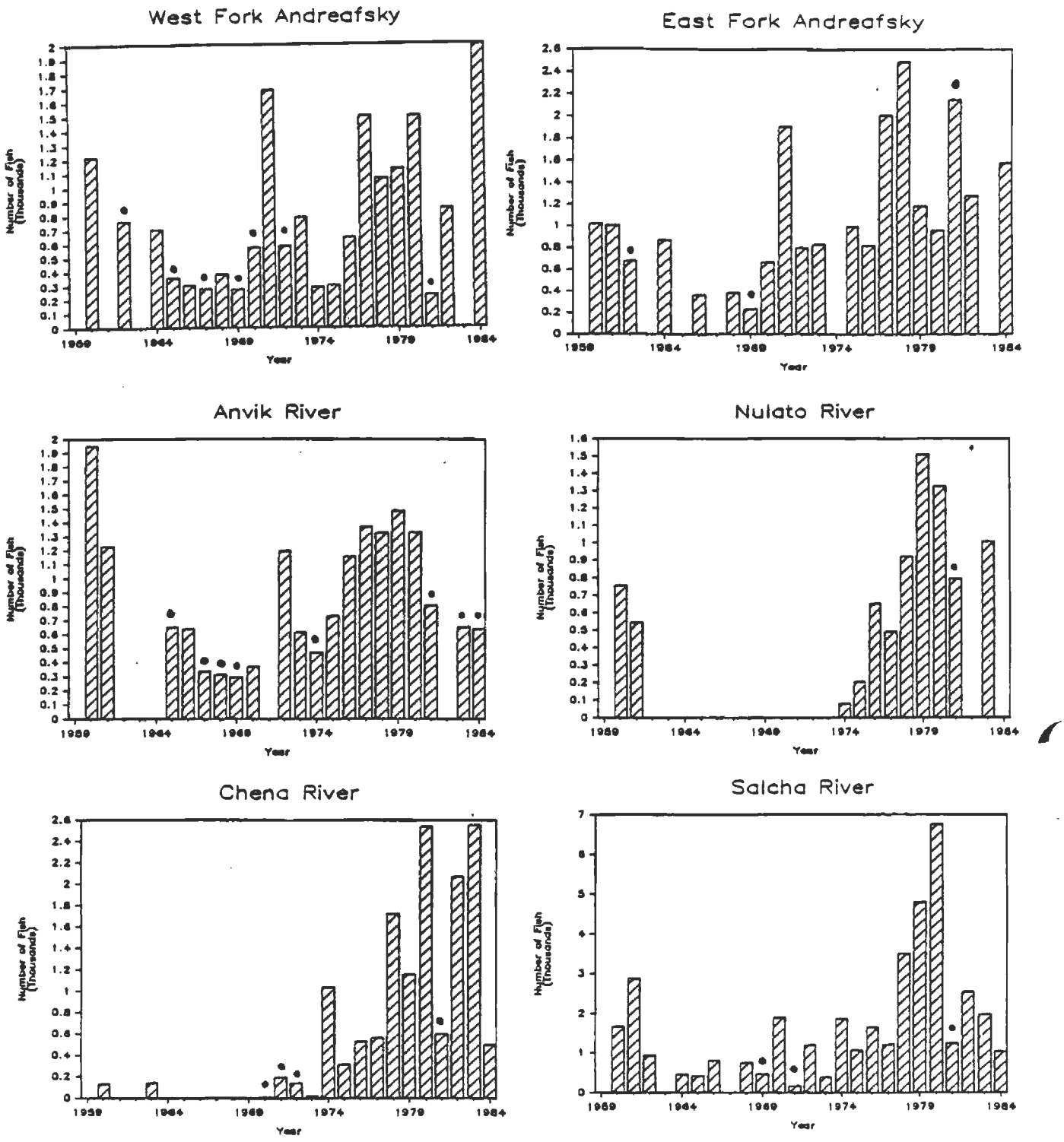


Figure 12. Chinook salmon escapement indices to selected Yukon River spawning areas, 1959-1984. (Aerial survey estimates unless otherwise noted. ● = poor survey conditions.)

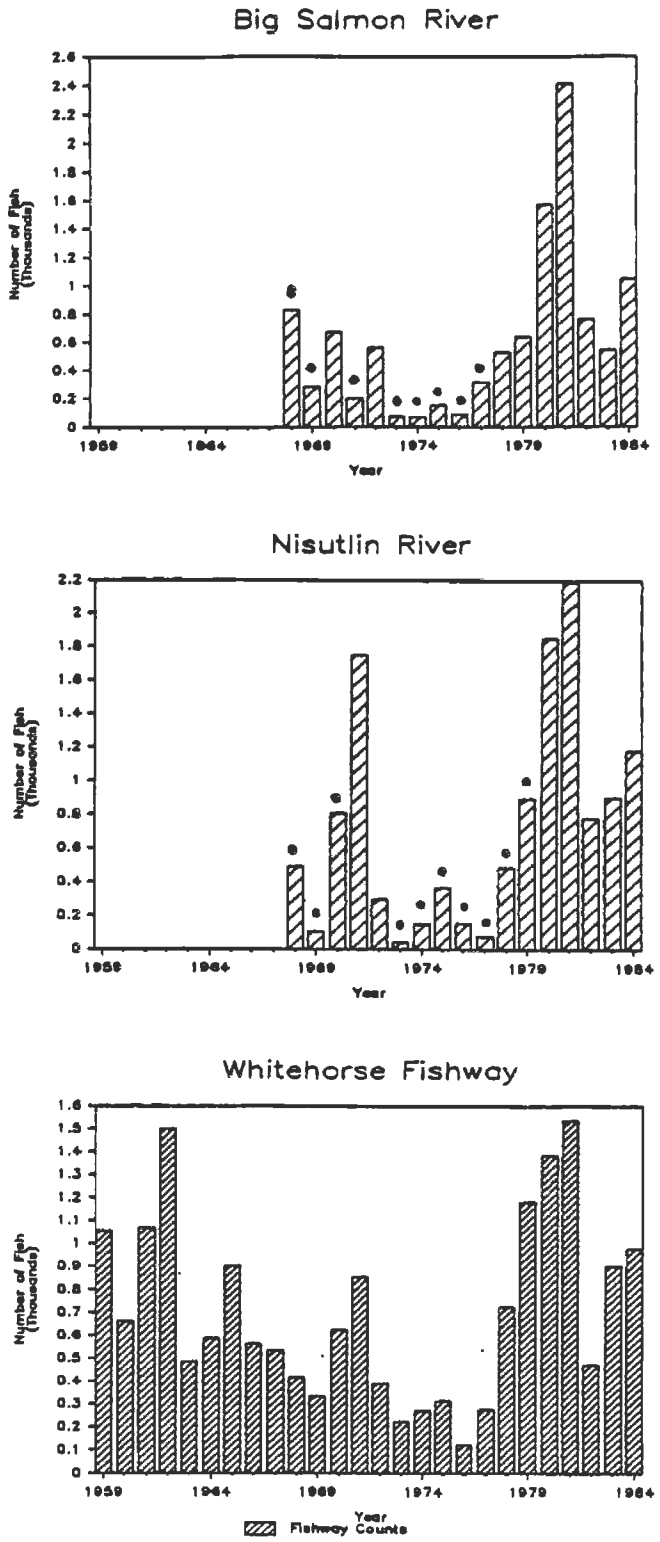


Figure 12 (Continued). Chinook salmon escapement indices to selected Yukon River spawning areas, 1959-1984. (Aerial survey estimates unless otherwise noted. ● = poor survey conditions.)

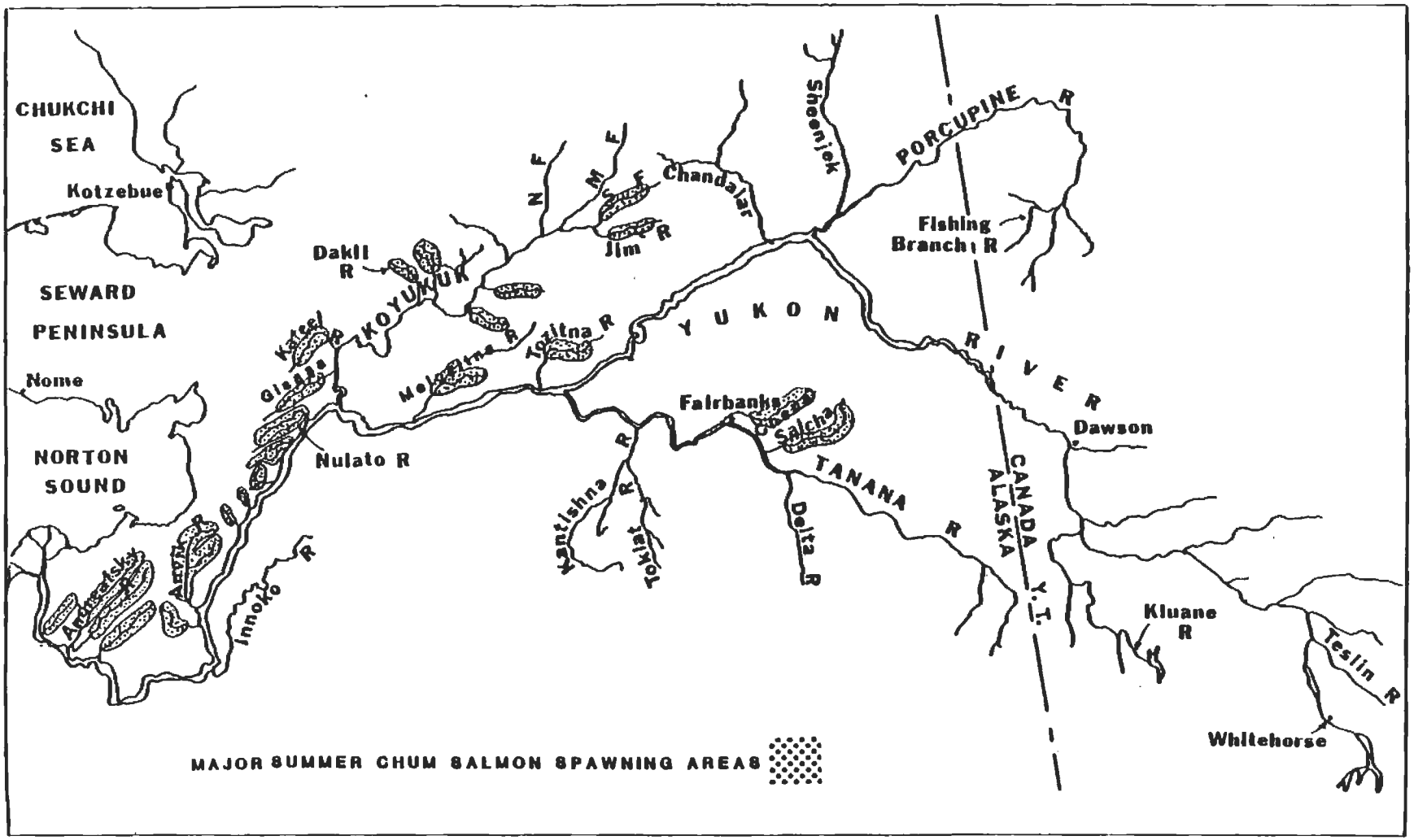


Figure 13. Summer chum salmon spawning areas in the Yukon River drainage. (Not drawn to scale.)

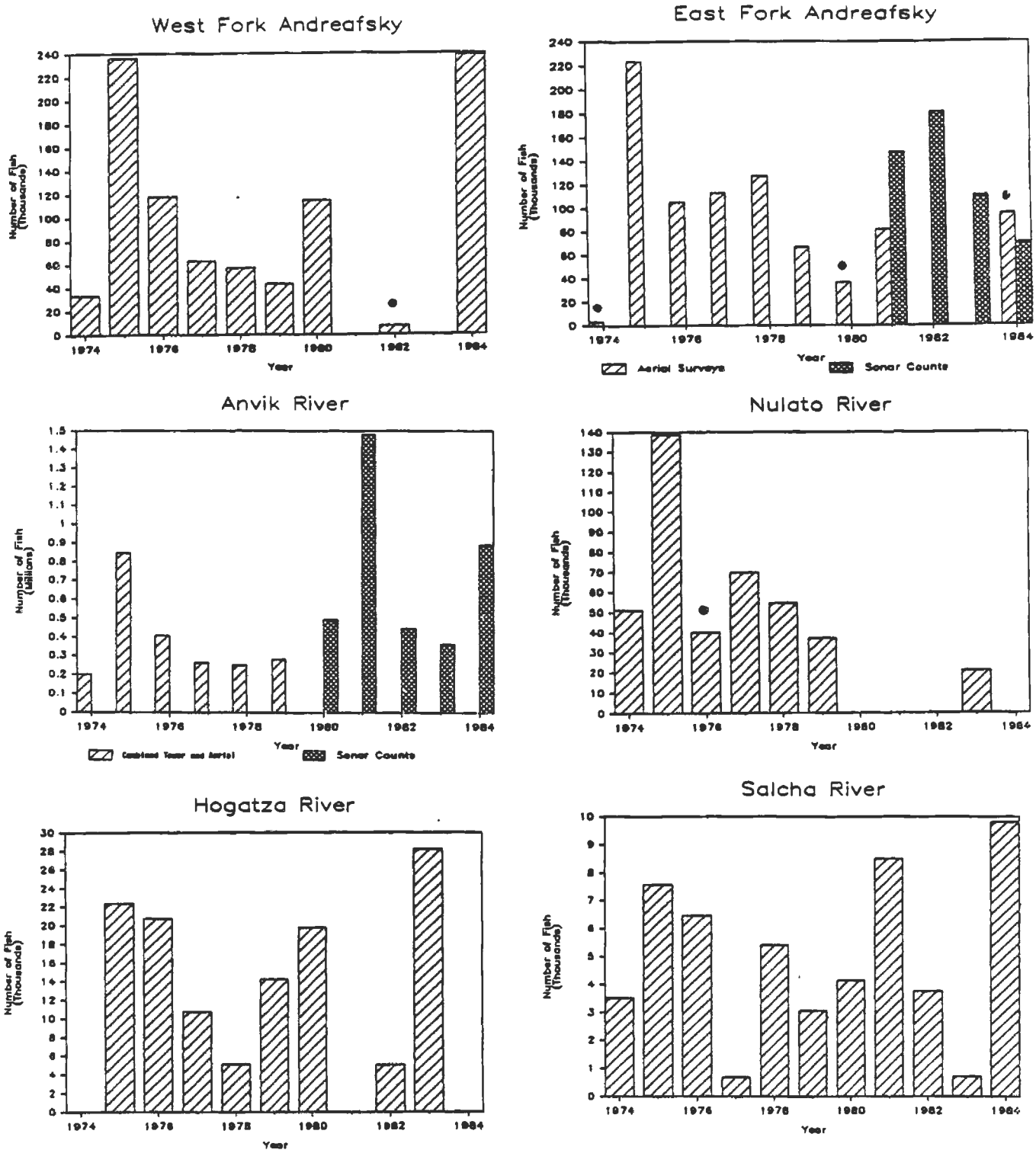


Figure 14. Summer chum salmon escapement indices to selected Yukon River spawning areas, 1974-1984. (Aerial survey estimates unless otherwise noted. ● = poor survey conditions.)

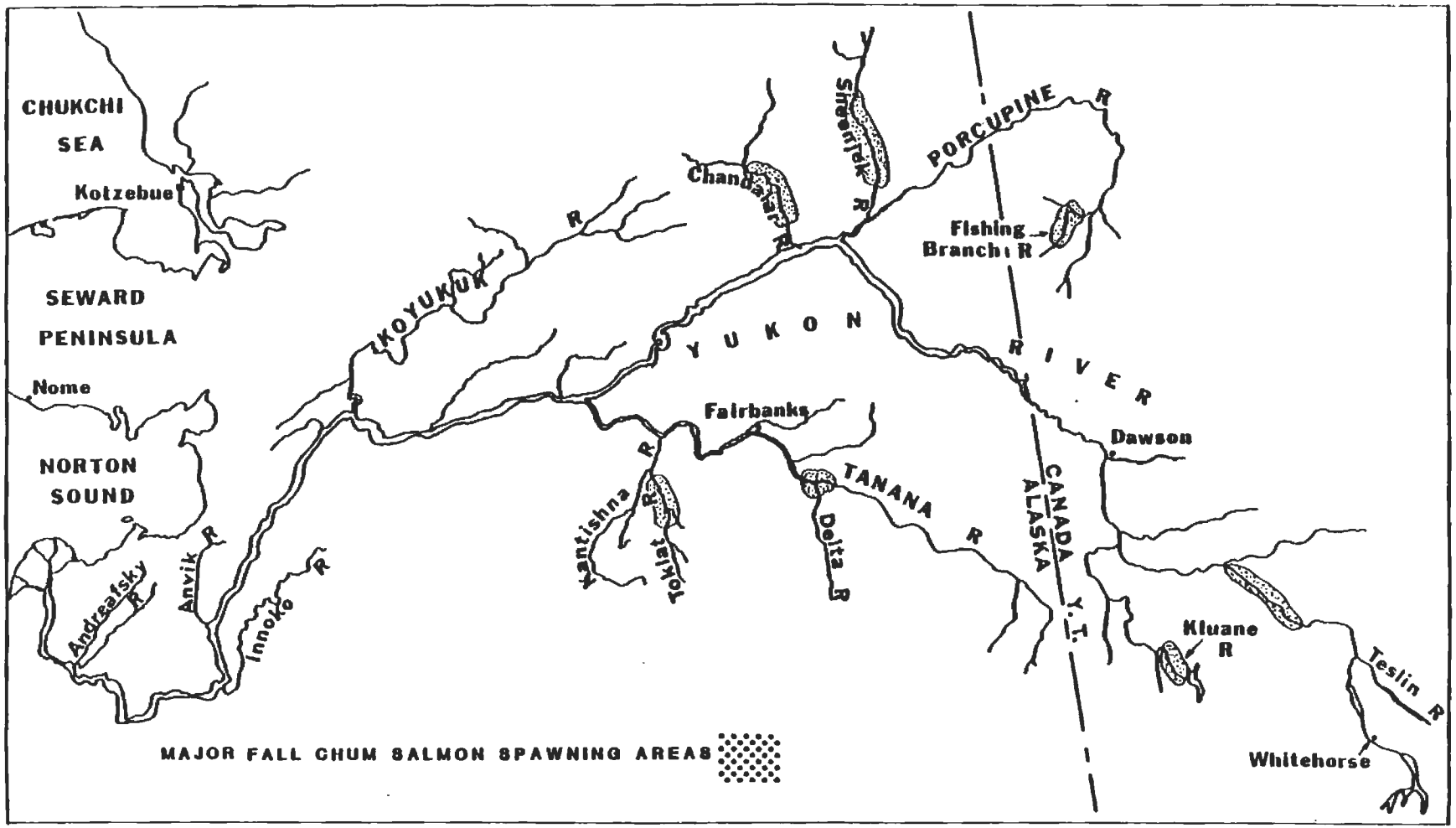


Figure 15. Fall chum salmon spawning areas in the Yukon River drainage. (Not drawn to scale.)

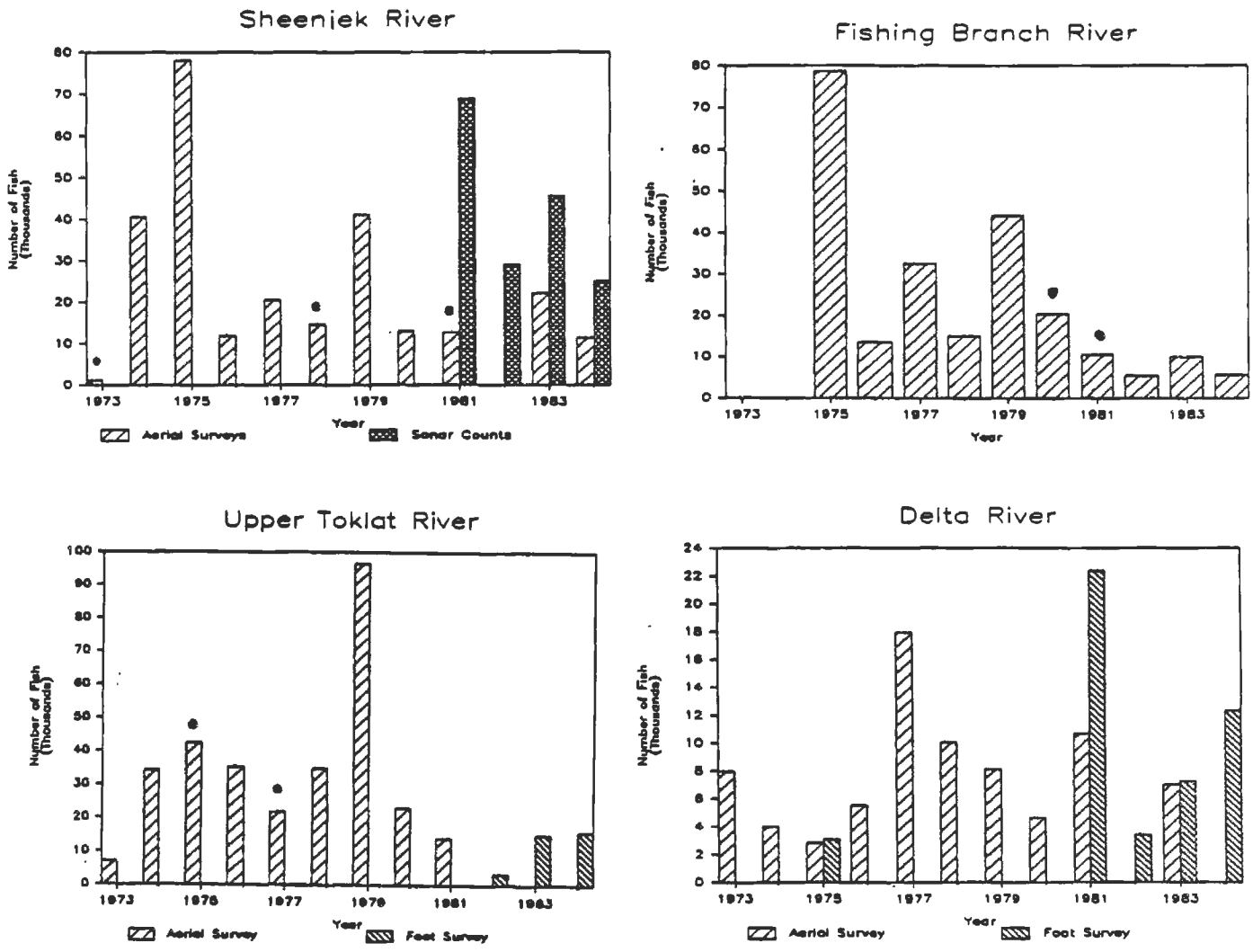


Figure 16. Fall chum salmon escapement indices to selected Yukon River spawning areas, 1973-1984. (Aerial survey estimates unless otherwise noted. ● = poor survey conditions.)

Table 1. Chinook and fall chum salmon commercial fishing season, weekly fishing schedule and actual fishing time in district 1 and 2 of Yukon Area (Alaska) 1961-1984.

	CHINOOK SALMON SEASON 1/			FALL CHUM SALMON SEASON 2/				
	Season Opening Date	Weekly Fishing Schedule	Actual Fishing Hours (Districts 1 and 2)	Season Opening Date	Weekly Fishing Schedule	Actual Fishing Hours District 1	District 2	Total
1961	June 1	4 consecutive days	852	Opening not specified through Sept. 30	4 consecutive days	384	-	384
1962	"	"	818	"	"	504	-	504
1963	"	4 days (two-48 hr. periods)	774	"	4 days (two-48 hr. periods)	432	-	432
1964	"	"	606	"	"	408	-	408
1965	"	"	720	August 1	"	3/	-	3/
1966	"	"	552	"	"	672	-	672
1967	"	"	744	Opening not specified through Sept. 30	"	504	-	504
1968	"	3 1/2 days (one-48 hr period & one-36 hr period)	746	"	3 1/2 days (one-48 hr period & one 36 hr period)	528	-	528
1969	"	"	660	Open by Emergency Order through Sept 30	"	480	120	600
1970	"	"	636	"	4 days (two-48 hr periods)	528	456	984
1971	"	"	528	"	"	528	240	768
1972	"	"	552	"	"	948	480	1,428
1973	"	"	540	"	"	996	624	1,620
1974	"	3 days (two-36 hr periods)	576	Open by Emergency Order through Aug. 31	3 days (two-36 hr periods)	588	288	876
1975	"	"	420	"	"	624	288	912
1976	June 10	2 1/2 days (one 36 hr period & one-24 hr. period)	372	"	"	486	270	756
1977	"	"	386	"	"	528	252	780
1978	"	"	336	"	"	648	288	936
1979	"	"	312	"	2 days (two-24 hr periods)	600	168	768
1980	"	"	246	"	"	528	144	672
1981	Open by Emergency Order June 5-15	"	216	"	"	168	144	312
1982	"	Fishing Periods established by Emergency Order (2 days/week)	264	"	"	192	192	384
1983	"	"	192	Closed by E.O. 7/19 Dist. 1 (reopen 7/26) and closed 7/22 Dist. 2 (reopen 7/29)	Fishing Periods established by E.O. (1-2 days a week)	84-144 4/	84	168-228 4/
1984	"	"	168	"	"	78-138 4/	78	156-216 4/

1/ Chinook salmon season early June - early July.
2/ Fall chum salmon season mid-July - late August.
3/ Information not available.
4/ Variable fishing hours due to two-12 hour weekly fishing periods in set net only area in lower portion of district 1 and two-24 hour fishing periods in upper portion of district 1.

Table 2. Yukon River (Alaska) escapement index objectives for chinook and chum salmon.

	Escapement Objective 1/	
	Minimum	Optimum
CHINOOK SALMON		
Andreafsky River		
East Fork	1,100	1,600
West Fork	700	1,000
Anvik River (Mainstem Yellow River to McDonald Creek)	300	500
Nulato River		
North Fork		500
South Fork		500
Gisasa River		650
Chena River (Flood Control Dam to middle Fork)	1,000	1,700
Salcha River	1,500	3,500
SUMMER CHUM SALMON		
Andreafsky River		
East Fork	76,000	109,000
West Fork	62,000	116,000
Anvik River		
(Mainstem Goblet Creek to McDonald Cr.)	209,000	356,000
Sonar		487,000 2/
Nulato River		
North Fork	37,000	53,000
Hogatza River		
Clear Creek	5,000	8,000
Caribou Creek	5,000	9,000
Salcha River		
FALL CHUM SALMON		
Upper Tanana River Drainage		
Delta River		7,900
Bluff Cabin Slough		5,200
Upper Toklat River		
Peak Years 3/		69,000
Non-Peak Years		22,000
Sheenjek River		
Peak Years 3/		60,000
Non-Peak Years		19,000

1/ Escapement objectives in numbers of fish are preliminary and are subject to change as additional data becomes available. Unless otherwise indicated, escapement objectives are based on aerial survey index estimates which do not represent total escapement, but do reflect annual spawner abundance trends when using standard survey methods under acceptable survey conditions.

2/ Optimim number calculated from escapement-return relationships.

3/ Four year cycle in 1971, 1975, 1979 etc.

Table 3. Summary of Yukon River chinook salmon population estimates cited in literature. (1)

Year	Portion of Run	Method (2)	Population Estimate	Source
1961	Above Rampart	3	17,000	USFWS. 1964. Rampart Canyon dam and reservoir project, Yukon River. 122 pp.
1962	Above Rampart	3	22,000	USFWS. 1964.
1966	Entire River	1	310,000-342,000	ADFG. 1966. Annual Management Report A-Y-K Area. Commercial Fisheries Division, Anchorage. 117 pp.
1967	Entire River	1	397,000-600,000	Geiger, M.F., R.I. Regnart, and R. Baxter. 1967. A-Y-K Area anadromous fish investigations. ADFG, Juneau. 82 pp.
1968	Entire River	1	190,000	Geiger, M.F., R.I. Regnart, R. Baxter, and C. Yanagawa. 1968. A-Y-K Area anadromous fish investigations. ADFG, Juneau. 113 pp.
1969	Entire River	1	161,000	Lebida, R.C. 1969. A-Y-K Area anadromous fish investigations. ADFG, Juneau. 77 pp.
1970	Entire River	1	227,000	Lebida, R.C. 1970. Yukon River anadromous fish investigations. ADFG, Juneau. 48 pp.
1973	Yukon Territory Excl Porcupine	4	29,000	Sweitzer, O. 1974. Distribution and abundance of chinook (Oncorhynchus tshawytscha) and chum (O. keta) salmon in the upper Yukon River system in 1973, as determined by a tagging program. Environment Canada-FMS. 24 pp.
1974	Yukon Territory Excl Porcupine	4	11,000-37,000	Brock, D.N. 1976. Distribution and abundance of chinook (Oncorhynchus tshawytscha) and chum (O. keta) salmon in the upper Yukon River system in 1974 as determined by a tagging program. Environment Canada-FMS. 56 pp.
1982	Yukon Territory Excl Porcupine	4	37,000	Milligan, P.A., W.O. Rublee, D.D. Cornett, and R.A.C. Johnston. 1984. The distribution and abundance of chinook salmon (Oncorhynchus tshawytscha) in the upper Yukon River basin as determined by a radio-tagging and spaghetti-tagging program: 1982-1983. Yukon River Basin Study, Fisheries Work Group, Project No. 35a. DFO, Whitehorse, Y.T.
1983	Yukon Territory Excl Porcupine	4	48,000	Milligan, P.A., et al. 1984.

(1) Population estimates rounded to the nearest thousand fish.

(2) Method: 1-Tagging estimate plus commercial and subsistence harvests.
2-Commercial and subsistence harvests plus escapement indices. These are minimum estimates since escapement data are incomplete and in most cases are only an index of abundance.
3-Tagging estimate with recoveries only from agency fishing sites.
4-Tagging estimate with recoveries from commercial and subsistence fisheries.

Table 4. Summary of Yukon River summer chum salmon population estimates cited in literature. (1)

Year	Portion of Run	Method (2)	Population Estimate	Source
1970	Entire River	1	3,630,000	Lebida, R.C. 1970. Yukon River anadromous fish investigations. ADFG, Juneau. 48 pp.
1971	Entire River	3	1,560,000	Lebida, R.C. 1972. Yukon River anadromous fish investigations. ADFG, Juneau. 45 pp.
1972	Entire River	2	1,548,000	Buklis, L.S. 1982. Anvik River summer chum salmon stock biology. ADFG Informational Leaflet No. 204. Juneau. 50 pp.
1973	Entire River	2	1,152,000	Buklis, L.S. 1982.
1974	Entire River	2	2,017,000	Buklis, L.S. 1982.
1975	Entire River	2	3,528,000	Buklis, L.S. 1982.
1976	Entire River	2	2,137,000	Buklis, L.S. 1982.
1977	Entire River	2	1,706,000	Buklis, L.S. 1982.
1978	Entire River	2	2,207,000	Buklis, L.S. 1982.
1979	Entire River	2	1,799,000	Buklis, L.S. 1982.
1980	Entire River	2	2,734,000	Buklis, L.S. 1982.
1981	Entire River	2	5,624,000	Buklis, L.S. 1982.

(1) Population estimates rounded to the nearest thousand fish.

(2) Method: 1-Tagging estimate plus commercial and subsistence harvests.
2-Commercial and subsistence harvests plus escapement indices. These are minimum estimates since escapement data are incomplete and in most cases are only an index of abundance.
3-Tagging estimate with recoveries only from agency fishing sites.
4-Tagging estimate with recoveries from commercial and subsistence fisheries.

Table 5. Summary of Yukon River fall chum salmon population estimates cited in literature. (1)

Year	Portion of Run	Method (2)	Population Estimate	Source
1961	Above Rampart	3	131,000	USFWS. 1964. Rampart Canyon dam and reservoir project. Yukon River. 122 pp.
1962	Above Rampart	3	114,000	USFWS. 1964.
1973	Yukon Territory Excl Porcupine	4	40,000	Sweitzer, O. 1974. Distribution and abundance of chinook (Oncorhynchus tshawytscha) and chum (O. keta) salmon in the upper Yukon River system in 1973, as determined by a tagging program. Environment Canada-FMS. 24 pp.
1974	Entire River	2	521,000	Buklis, L.S. and L.H. Barton. 1984. Yukon River fall chum salmon biology and stock status. ADFG Informational Leaflet No. 239. 67 pp.
	Yukon Territory Excl Porcupine	4	16,000-31,000	Brock, D.N. 1976. Distribution and abundance of chinook (Oncorhynchus tshawytscha) and chum (O. keta) salmon in the upper Yukon River system in 1974 as determined by a tagging program. Environment Canada-FMS. 56 pp.
1975	Entire River	2	620,000	Buklis, L.S. and L.H. Barton. 1984.
1976	Entire River	2	312,000	Buklis, L.S. and L.H. Barton. 1984.
	Above Tanana Village	4	197,000	Buklis, L.S. 1981. Yukon and Tanana River fall chum salmon tagging study, 1976-1980. ADFG Informational Leaflet No. 194. 40 pp.
1977	Entire River	2	463,000	Buklis, L.S. and L.H. Barton. 1984.
	Above Tanana Village	4	412,000	Buklis, L.S. 1981.
1978	Entire River	2	443,000	Buklis, L.S. and L.H. Barton. 1984.
	Above Tanana Vil Excl Tanana R	4	165,000	Buklis, L.S. 1981.
1979	Entire River	2	927,000	Buklis, L.S. and L.H. Barton. 1984.
	Tanana River Drainage	4	676,000	Buklis, L.S. 1981.
1980	Entire River	2	567,000	Buklis, L.S. and L.H. Barton. 1984.
	Tanana River Drainage	4	384,000	Buklis, L.S. 1981.
1981	Entire River	2	788,000	Buklis, L.S. and L.H. Barton. 1984.
1982	Entire River	2	392,000	Buklis, L.S. and L.H. Barton. 1984.
	Yukon Territory Excl Porcupine	4	47,000	Milligan, P.A., W.O. Rublee, D.D. Cornett, and R.A.C. Johnston. 1984. The distribution and abundance of chum salmon (Oncorhynchus keta) in the upper Yukon River basin as determined by a radio-tagging and spaghetti tagging program: 1982-1983. Yukon River Basin Study, Fisheries Work Group Project No. 35b. DFO, Whitehorse, YT. 128 pp.
1983	Entire River	2	608,000	Buklis, L.S. and L.H. Barton. 1984.
	Yukon Territory Excl Porcupine	4	118,000	Milligan, P.A., et al. 1984.
1984	Entire River	2	444,000	ADFG. 1984. Annual management report Yukon Area. Commercial Fisheries Division, Anchorage. 133 pp.

(1) Population estimates rounded to the nearest thousand fish.

(2) Method: 1-Tagging estimate plus commercial and subsistence harvests.
2-Commercial and subsistence harvests plus escapement indices. These are minimum estimates since escapement data are incomplete and in most cases are only an index of abundance.
3-Tagging estimate with recoveries only from agency fishing sites.
4-Tagging estimate with recoveries from commercial and subsistence fisheries.

Table 6. Total catch and estimated catch of Western Alaska (including Canadian Yukon) chinook salmon (in thousands of fish) in Japanese high seas salmon gillnet fisheries, 1964-1984 1/

Year	Mothership 2/		Landbased		Combined	
	Total Catch	WA Catch	Total Catch	WA Catch	Total Catch	WA Catch
1964	410	179	208	40	618	219
1965	185	106	102	20	287	126
1966	208	108	118	22	326	130
1967	128	71	115	22	243	93
1968	362	244	97	18	459	262
1969	554	367	88	17	642	384
1970	437	312	148	28	585	340
1971	206	132	139	27	345	159
1972	261	189	107	20	368	209
1973	119	56	165	31	284	87
1974	361	208	188	36	549	244
1975	162	108	137	20	299	407
1976	285	117	201	42	486	159
1977	93	55	146	31	239	86
1978	105	36	210	63	315	99
1979	126	69	160	45	286	114
1980	704	416	160	22	864	438
1981	88	30	190	55	278	85
1982	107	45	165	41	272	86
1983	87	31	178	44	265	75
1984	82	31	92	-	174	-

1/ Sources

1964-83: Rogers, Donald et el, 1984. Origins of chinook salmon in the area of Japanese Mothership Fishery, Fisheries Research Institute, University of Washington. 215 pgs.

1984 WA catch estimate for mothership fishery: Mike Dahlburg, National Marine Fisheries Service, Juneau, Ak.

2/ Western Alaska catches represent fish from Bristol Bay Area, Kuskokwim Area and Yukon River.

Table 7. Salmon catches in thousands of fish made in the foreign groundfish trawl fisheries, 1977-1984. 1/

Bering Sea - Aleutians Area

Year	Foreign Chinook	Foreign Chum	Foreign Other	Foreign Total	Joint - Venture Chinook	Joint - Venture Chum	Joint - Venture Other	Joint - Venture Total	Combined Chinook	Combined Chum	Combined Other	Combined Total
1977	-	-	-	47.8 2/					-	-	-	47.8 2/
1978	39.1	4.8	.6	44.5					39.1	4.8	.6	44.5
1979	100.4	6.1	1.2	107.7					100.4	6.1	1.2	107.7
1980	113.2	6.7	.2	120.1	1.9	0	0	1.9	115.1	6.7	.2	122.0
1981	36.7	6.0	.6	43.3	.3	.4	.1	.8	37.0	6.4	.7	44.1
1982	13.9	7.1	.2	21.2	1.7	.6	.1	2.4	15.6	7.7	.3	23.6
1983	9.8	8.2	.2	18.2	.5	24.0	(<.1)	24.5	10.3	32.2	.2	42.7
1984	-	-	-	12.8	-	-	-	60.4	-	-	-	73.2 2/ 3/

Gulf of Alaska

1977	4.8	0.5	(<.1)	5.3								
1978	-	-	-	45.6 2/								
1979	16.9	2.9	.6	20.4	1.0	.1	0	1.1	17.9	3.0	.6	21.5
1980	31.6	4.2	.1	35.9	.2	0	0	.2	31.8	4.2	.1	36.1
1981	28.6	2.0	.3	30.9	0	0	0	.0	28.6	2.0	.3	30.9
1982	-	-	-	5.6 2/	-	-	-	1.4 2/	5.9	.9	.2	7.0
1983	5.9	3.6	.1	9.6	3.5	.6	.1	4.2	9.4	4.2	.2	13.8

1/ Sources: a) Renold E. Narita, et al. 1985. Summary data on incidental catch of salmon, National Marine Fisheries Service, Seattle, Washington, unpublished report, 34 pages.

b) Janet Smoker, National Marine Fisheries Service, Juneau, Alaska, provided some of the data (species composition).

2/ Species composition unknown.

3/ Partial catches for January-November.

Appendix Table 1. Yukon River drainage commercial and subsistence salmon catches, 1903-1984.

	Commercial Catch										
	Alaska				Yukon Territory			Total			
Year	Chinook	Coho	Chum	Total	Chinook	Chum	Total	Chinook	Coho	Chum	Total
1903							4,666 8/				4,666
1904											
1905											
1906											
1907											
1908							7,000				7,000
1909							9,238				9,238
1910											
1911											
1912											
1913							12,133				12,133
1914							12,573				12,573
1915							10,466				10,466
1916							9,566				9,566
1917											
1918	12,239	26,144	73,921	112,304			7,066	12,239	26,144	73,921	119,370
1919	104,822	37,070	327,898	469,790 9/			1,800	104,822	37,070	327,898	471,590
1920	58,467		155,655	214,122 9/			12,000	58,467		155,655	226,122
1921	69,646	1,000	111,098	181,744			10,840	69,646	1,000	111,098	192,584
1922	16,825			16,825			2,420	16,825			19,245
1923	13,393			13,393			1,833	13,393			15,226
1924	27,375			27,375			4,560	27,375			31,935
1925							3,900				3,900
1926							4,373				4,373
1927							5,366				5,366
1928							5,733				5,733
1929							5,266				5,266
1930							3,660				3,660
1931							3,473				3,473
1932	4,739			4,739			4,200	4,739			8,939
1933	8,829			8,829			3,333	8,829			12,162
1934	25,365			25,365			2,000	25,365			27,365
1935	7,265			7,265			3,466	7,265			10,731
1936	20,963			20,963			3,400	20,963			24,363
1937	6,226			6,226			3,746	6,226			9,972
1938	13,727			13,727			860	13,727			14,587
1939	9,987			9,987			720	9,987			10,707
1940	18,053			18,053			1,153	18,053			19,206
1941	29,905			29,905			2,806	29,905			32,711
1942	22,487			22,487			713	22,487			23,200
1943	27,650			27,650			609	27,650			28,259
1944	14,232			14,232			986	14,232			15,218
1945	19,727			19,727			1,333	19,727			21,060
1946	22,782			22,782			353	22,782			23,135
1947	54,026			54,026			120	54,026			54,146
1948	33,842			33,842				33,842			33,842
1949	36,379			36,379				36,379			36,379
1950	41,808			41,808				41,808			41,808
1951 3/	56,278			56,278				56,278			56,278
1952	38,637	10,868		49,505				38,367	10,868		49,505
1953	58,859		5,977	64,836				58,859		5,977	64,836
1954	64,545		14,375 4/	78,290				64,545		14,375	78,920
1955	55,925			55,925				55,925			55,925
1956	62,208	1	10,742 5/	72,951				62,208	1	10,742	72,951
1957	63,623			63,623				63,623			63,623
1958	63,375			63,375	3,000	1,500	4,500	7/66,735		1,500	68,235
1959	78,370			78,370	2,477	1,098	3,575	80,847		1,098	81,945
1960 6/	67,597			67,597	4,058	5,493	9,551	71,655		5,493	77,148
1961	119,664	2,855	42,461	165,096 5/	3,446	3,276	6,722	123,110	2,855	45,737	171,818
1962	94,734	22,926	53,116	170,820 5/	4,037	936	4,973	98,771	22,926	54,052	175,793
1963	117,048	5,572	-	122,623 5/	2,283	2,196	4,479	119,331	5,572	2,196	127,102
1964	93,587	2,446	8,347	104,380	3,208	1,929	5,137	96,795	2,446	10,276	109,517
1965	118,098	350	23,317	141,765	2,265	2,071	4,336	120,363	350	25,388	146,101
1966	93,315	19,254	71,045	183,614 5/	1,942	3,157	5,099	95,257	19,254	74,202	188,713
1967	129,656	11,047	49,209	190,115 5/	2,187	3,343	5,530	131,893	11,047	52,552	195,645
1968	106,526	13,303	67,375	187,204	2,212	453	2,665	108,738	13,303	67,828	189,869
1969	91,027	15,093	193,276	299,396	1,640	2,279	3,919	92,667	15,093	195,555	303,315
1970	79,145	13,188	346,601	439,189 5/	2,611	2,479	5,090	81,756	13,188	349,080	444,279
1971	110,507	12,203	289,684	412,395 5/	3,178	1,761	4,939	113,685	12,203	291,445	417,334
1972	92,840	22,233	287,844	402,917	1,769	2,532	4,301	94,609	22,233	290,376	407,218
1973	75,353	36,641	517,599	629,694 5/	2,199	2,806	5,005	77,552	36,641	520,405	634,699
1974	98,089	16,777	879,668	994,534	1,808	2,544	4,352	99,897	16,777	882,212	998,886
1975	63,838	2,546	985,304	1,051,796 5/	3,000	2,500	5,500	66,836	2,546	987,804	1,057,296
1976	87,776	5,184	757,284	850,285 5/	3,500	1,000	4,500	91,276	5,184	758,284	854,785
1977	96,757	38,863	792,861	928,481	4,720	3,990	8,710	101,477	38,863	796,851	937,191
1978	99,168	26,152	1,288,609	1,413,930 5/	2,975	3,356	6,331	102,143	26,152	1,291,965	1,420,261
1979	127,673	17,165	1,139,262	1,284,107 5/	6,175	9,084	15,259	133,848	17,165	1,148,346	1,299,366
1980	153,985	8,745	1,222,039	1,384,769	9,500	9,000	18,500	163,485	8,745	1,231,039	1,403,269
1981	158,018	23,680	1,473,389	1,655,087	8,593	15,260	23,853	166,611	23,680	1,488,649	1,678,940
1982	123,644	37,176	685,611	846,431	8,640	11,312	19,952	132,284	37,176	696,923	866,383
1983	147,910	13,320	1,047,477	1,208,707	13,027	25,990	39,017	160,937	13,320	1,073,467	1,247,724
1984	119,904	81,940	796,829	998,673	9,885	22,932	32,817	129,789	81,940	819,761	1,031,490

Appendix Table 1. (Continued)

Year	Subsistence Catch								
	Alaska 1/			Yukon Territory 10/			Total		
	Chinook	Other Salmon 2/	Total	Chinook	Other Salmon	Total	Chinook	Other Salmon 2/	Total
1903									
1904									
1905									
1906									
1907									
1908									
1909									
1910									
1911									
1912									
1913									
1914									
1915									
1916									
1917									
1918		1,400,000	1,400,000					1,400,000	1,400,000
1919		269,000	269,000					269,000	269,000
1920	20,000	860,000	880,000				20,000	860,000	880,000
1921									
1922	15,000	330,000	345,000				15,000	330,000	345,000
1923	17,500	435,000	452,500				17,500	435,000	452,500
1924		1,130,000	1,130,000					1,130,000	1,130,000
1925	15,000	259,000	274,000				15,000	259,000	274,000
1926	20,500	555,000	575,500				20,500	555,000	575,500
1927		520,000	520,000					520,000	520,000
1928		670,000	670,000					670,000	670,000
1929		537,000	537,000					537,000	537,000
1930		633,000	633,000					633,000	633,000
1931	26,693	565,000	591,693				26,693	565,000	591,693
1932	23,160	1,092,000	1,115,160				23,160	1,092,000	1,115,160
1933	19,950	603,000	622,950				19,950	603,000	622,950
1934		474,000	474,000					474,000	474,000
1935	20,400	537,000	557,400				20,400	537,000	557,400
1936	22,750	560,000	582,750				22,750	560,000	582,750
1937	5,528	346,000	351,528				5,528	346,000	351,528
1938	19,244	340,450	359,694				19,244	340,450	359,694
1939	18,050	327,650	345,700				18,050	327,650	345,700
1940	14,400	1,029,999	1,043,400				14,400	1,029,000	1,043,400
1941	17,703	438,000	455,703				17,703	438,000	455,703
1942		197,000	197,000					197,000	197,000
1943		200,000	200,000					200,000	200,000
1944									
1945									
1946									
1947									
1948									
1949									
1950									
1951									
1952									
1953		380,000	380,000					380,000	380,000
1954									
1955									
1956									
1957									
1958	11,890	337,500	349,390	8,000		8,000	19,890	337,500	357,390
1959				5,957	2,000 7/	7,957	7,957	2,000	7,957
1960				5,595	10,115	15,710	5,595	10,115	15,710
1961	21,488	407,089	428,577	9,800	5,800	15,600	31,288	412,889	444,177
1962	11,110	349,141	360,251	9,900	8,500	18,400	21,010	357,641	378,651
1963	24,862	396,125	420,987	7,794	25,500	33,294	32,656	421,625	454,281
1964	16,231	481,440	497,671	4,200	10,258	14,458	20,431	491,698	512,129
1965	16,608	449,131	465,739	3,115	9,718	12,833	19,723	458,849	478,572
1966	11,572	206,011	217,583	2,510	10,035	12,545	14,082	216,046	230,128
1967	16,448	274,977	291,425	2,963	13,618	16,581	19,411	288,595	308,006
1968	12,106	178,507	190,613	2,830	11,180	14,010	14,936	189,687	204,623
1969	14,000	208,254	222,254	984	5,497	6,481	14,984	213,751	228,735
1970	13,874	222,005	235,879	2,052	1,232	3,284	15,926	223,237	239,163
1971	25,684	228,649	254,333	3,269	15,150	18,419	28,953	243,799	272,752
1972	20,258	144,008	164,266	3,960	5,000	8,960	24,218	149,008	173,226
1973	24,317	214,682	238,999	2,323	7,329	9,652	26,640	222,011	248,651
1974	19,964	321,587	341,551	3,823	9,102	12,925	23,787	330,689	354,476
1975	13,045	298,479	311,524	3,000	18,100	21,100	16,045	316,579	332,624
1976	17,806	259,199	277,005	1,525	4,200	5,725	19,331	263,399	282,730
1977	17,581	258,606	276,187	2,807	8,489	11,296	20,388	267,095	287,483
1978	27,391	293,581	320,972	2,906	6,210	9,116	30,297	299,791	330,088
1979	31,005	439,328	470,333	4,200	13,000	17,200	35,205	452,328	487,533
1980	42,724	465,213	507,937	13,046	13,218	26,264	55,770	478,431	534,201
1981	29,690	418,037	447,727	9,216	7,021	16,237	38,906	425,058	463,964
1982	28,158	429,760	457,918	8,268	4,779	13,047	36,426	434,539	470,965
1983	49,478	457,211	506,689	5,625	3,500	9,125	55,103	460,711	515,814
1984	42,389	454,165	496,554	6,610	6,335	12,945	48,999	460,500	509,444

Appendix Table 1. (Continued)

	Total Utilization								
	Alaska			Yukon Territory			Total		
Year	Chinook	Other Salmon 2/	Total	Chinook	Other Salmon	Total	Chinook	Other Salmon 2/	Total
1903						4,666			4,666
1904									
1905									
1906									
1907									
1908						7,000			7,000
1909						9,238			9,238
1910									
1911									
1912									
1913						12,133			12,133
1914						12,573			12,573
1915						10,466			10,466
1916						9,566			9,566
1917									
1918	12,239	1,500,065	1,512,304			7,066	12,239	1,500,065	1,519,370
1919	104,822	738,790	843,612			1,800	104,822	740,590	845,412
1920	78,467	1,015,655	1,094,122			12,000	78,467	1,015,655	1,106,122
1921	69,646	112,098	181,744			10,840	69,646	112,098	192,584
1922	31,825	330,000	361,825			2,420	31,825	330,000	364,245
1923	30,893	435,000	465,893			1,833	30,893	435,000	467,726
1924	27,375	1,130,000	1,157,375			4,560	27,375	1,130,000	1,161,935
1925	15,000	259,000	274,000			3,900	15,000	259,000	277,900
1926	20,500	555,000	575,500			4,373	20,500	555,000	579,873
1927		520,000	520,000			5,366		520,000	525,366
1928		670,000	670,000			5,733		670,000	675,733
1929		537,000	537,000			5,226		537,000	542,226
1930		633,000	633,000			3,660		633,000	636,660
1931	26,693	565,000	591,693			3,473	26,693	565,000	595,166
1932	27,899	1,092,000	1,119,899			4,200	27,899	1,092,000	1,124,099
1933	28,779	603,000	631,779			3,333	28,779	603,000	635,112
1934	23,365	474,000	497,365			2,000	23,365	474,000	499,365
1935	27,665	537,000	564,665			3,466	27,665	537,000	568,131
1936	43,713	560,000	603,713			3,400	43,713	560,000	607,113
1937	12,154	346,000	358,154			3,746	12,154	346,000	361,900
1938	32,971	340,450	373,421			860	32,971	340,450	374,281
1939	28,037	327,650	355,687			720	28,037	327,650	356,407
1940	32,453	1,029,000	1,061,453			1,153	32,453	1,029,000	1,062,606
1941	47,608	438,000	485,608			2,806	47,608	438,000	488,414
1942	22,487	197,000	219,487			713	22,487	197,000	220,200
1943	27,650	200,000	227,650			609	27,650	200,000	228,259
1944	14,232		14,232			986	14,232		15,218
1945	19,727		19,727			1,333	19,727		21,060
1946	22,782		22,782			353	22,782		23,135
1947	54,026		54,026			120	54,026		54,146
1948	33,842		33,842				33,842		33,842
1949	36,379		36,379				36,379		36,379
1950	41,808		41,808				41,808		41,808
1951	56,278		56,278				56,278		56,278
1952	38,637	10,868	49,505				38,637	10,868	49,505
1953	58,859	385,977	444,836				58,859	385,977	444,836
1954	64,545	14,375	78,920				64,545	14,375	78,920
1955	55,925		55,925				55,925		55,925
1956	62,208	10,743	72,951				62,208	10,743	72,951
1957	63,623		63,623				63,623		63,623
1958	75,625	337,500	413,125	11,000	1,500	12,500	86,625	339,000	425,625
1959	78,370		78,370	8,434	3,098	11,532	86,804	3,098	89,902
1960	67,597	-	67,597	9,653	15,608	25,261	77,250	15,608	92,858
1961	141,152	452,521	593,673	13,246	9,076	22,322	154,398	461,597	615,955
1962	105,844	425,277	531,071	13,937	9,436	23,373	119,781	434,663	554,444
1963	141,910	401,700	543,610	10,077	27,696	37,773	151,987	429,396	581,383
1964	109,818	492,233	602,051	7,408	12,187	19,595	117,226	504,420	621,646
1965	134,706	472,798	607,504	5,380	11,789	17,169	140,086	484,587	624,673
1966	104,887	296,310	401,197	4,452	13,192	17,644	109,339	309,502	418,841
1967	146,104	335,436	481,540	5,150	16,961	22,111	151,254	352,397	503,651
1968	118,632	259,185	377,817	5,042	11,633	16,675	123,674	270,818	394,492
1969	105,027	416,623	521,650	2,624	7,776	10,400	107,651	424,399	532,050
1970	93,019	582,049	675,068	4,663	3,711	8,374	97,682	585,760	683,442
1971	136,191	530,537	666,728	6,447	16,911	23,358	142,638	547,448	690,086
1972	113,098	454,085	567,183	5,729	7,532	13,261	118,827	461,617	580,444
1973	99,670	769,023	868,693	4,522	10,135	14,657	104,192	779,158	883,350
1974	118,053	1,218,032	1,336,085	5,631	11,646	17,277	123,684	1,229,678	1,353,362
1975	76,883	1,286,437	1,363,320	6,000	20,600	26,600	82,883	1,307,037	1,389,920
1976	105,582	1,021,708	1,127,290	5,025	5,200	10,225	110,607	1,026,908	1,137,515
1977	114,338	1,090,330	1,204,668	7,527	12,479	20,006	121,865	1,102,809	1,224,674
1978	126,559	1,608,343	1,734,902	5,881	9,566	15,447	132,440	1,617,909	1,750,349
1979	158,678	1,595,762	1,754,440	10,375	22,084	32,459	169,053	1,617,846	1,786,899
1980	196,709	1,695,997	1,892,706	22,546	22,218	44,764	219,255	1,718,215	1,937,470
1981	187,708	1,915,106	2,102,814	17,809	22,281	40,090	205,517	1,937,387	2,142,904
1982	151,802	1,152,547	1,304,349	16,908	16,091	32,099	168,710	1,168,638	1,337,348
1983	197,388	1,518,008	1,715,396	18,652	29,490	48,142	216,040	1,547,498	1,763,538
1984	162,293	1,332,934	1,495,227	16,495	29,267	45,762	178,788	1,362,201	1,540,989

1/ Does not include subsistence catches from the villages outside of the Yukon River mouth.
2/ Mostly chum salmon, but includes small numbers of pink and coho salmon.
3/ Data source for Alaska commercial catches: USFWS Stat. Digest No. 50 for the years 1951-59, unless otherwise indicated.
4/ Data source: Alaska Fisheries and Fur-Seal Industry Report for 1954.
5/ Includes small numbers of pink or red salmon (less than 300).
6/ Data source for Alaska commercial catches: ADF&G Stat. Leaflets for years since 1960.
7/ Data source: Environment Canada, Fisheries Service (Whitehorse) since 1958.
8/ Catch data for years 1903-1947 obtained by dividing total poundage of mixed salmon by an arbitrary weight of 15 lbs. Species breakdown is unknown. Figures are considered conservative (data collected by Royal Canadian Mounted Police).
9/ Does not include sockeye catch of 300 fish in 1919 and 60 fish in 1920 estimated from case pack (Gilbert, C.H. 1924. The salmon of the Yukon River. Bull. U.S. Bur. Fish. 38:317-332).
10/ Indian food fishery and domestic fishery catches combined.

Appendix Table 2. Alaskan and Canadian total utilization of Yukon River chinook and fall chum salmon, 1960-1984. a/

Year	Chinook			Fall Chum		
	Canada b/	Alaska c/	Total	Canada b/	Alaska c/	Total
1960	9,653	67,597 d/	77,250	15,608	-- e/	15,608
1961	13,246	141,152	154,398	9,076	144,233	153,309
1962	13,937	105,844	119,781	9,436	140,401	149,837
1963	10,077	141,910	151,987	27,696	99,031 f/	126,727
1964	7,408	109,818	117,226	12,187	128,707	140,894
1965	5,380	134,706	140,086	11,789	135,600	147,389
1966	4,452	104,887	109,339	13,192	122,548	135,740
1967	5,150	146,104	151,254	16,961	107,018	123,979
1968	5,042	118,632	123,674	11,633	97,552	109,185
1969	2,624	105,027	107,651	7,776	183,373	191,149
1970	4,663	93,019	97,682	3,711	265,096	268,807
1971	6,447	136,191	142,638	16,911	246,756	263,667
1972	5,729	113,098	118,827	7,532	188,163	195,695
1973	4,522	99,670	104,192	10,135	285,174	295,309
1974	5,631	118,053	123,684	11,646	391,200	402,846
1975	6,000	76,883	82,883	20,600	368,770	389,370
1976	5,025	105,582	110,607	5,200	234,273	239,473
1977	7,527	114,338	121,865	12,479	340,157	352,636
1978	5,881	126,559	132,440	9,566	331,250	340,816
1979	10,375	158,678	169,053	22,084	593,293	615,377
1980	22,546	196,709	219,255	22,218	466,087	488,305
1981	17,809	187,708	205,517	22,281	654,976	677,257
1982	16,908	151,802	168,710	16,091	357,084	373,175
1983	18,652	197,388	216,040	29,490	495,528	525,018
1984	16,495	162,293	178,788	29,267	382,896	412,163
Average						
1960-64	10,864	113,264	124,128	14,801	102,474	117,275
1965-69	4,530	121,871	126,401	12,270	129,218	141,488
1970-74	5,398	112,006	117,405	9,987	275,278	285,265
1975-79	6,962	116,408	123,370	13,986	373,549	387,534
1980-84	18,482	179,180	197,662	23,869	471,314	495,184

a Catch in numbers of fish.
b Commercial, Indian Food, and Domestic catches combined.
c Commercial and Subsistence catches combined.
d Commercial catches only; subsistence catches not documented.
e Subsistence catch not documented; commercial fishery did not operate.
f Subsistence catch only; commercial fishery did not operate.

Appendix Table 3. Alaskan catches of Yukon River chinook salmon, 1961-1984.a/

Year	Subsistence	Commercial	Total
1961	21,488	119,664	141,152
1962	11,110	94,734	105,844
1963	24,862	117,048	141,910
1964	16,231	93,587	109,818
1965	16,608	118,098	134,706
1966	11,572	93,315	104,887
1967	16,448	129,656	146,104
1968	12,106	106,526	118,632
1969	14,000	91,027	105,027
1970	13,874	79,145	93,019
1971	25,684	110,507	136,191
1972	20,258	92,840	113,098
1973	24,317	75,353	99,670
1974	19,964	98,089	118,053
1975	13,045	63,838	76,883
1976	17,806	87,776	105,582
1977	17,581	96,757	114,338
1978	27,391	99,168	126,559
1979	31,005	127,673	158,678
1980	42,724	153,985	196,709
1981	29,690	158,018	187,708
1982	28,158	123,644	151,802
1983	49,478	147,910	197,388
1984	42,389	119,904	162,293
Average			
1961-64	18,423	106,258	124,681
1965-69	14,147	107,724	121,871
1970-74	20,819	91,187	112,006
1975-79	21,366	95,042	116,408
1980-84	38,488	140,692	179,180

a Catch in numbers of fish.

ppendix Table 4. Canadian catch of Yukon River chinook salmon (including Porcupine River), 1960-1984. a/

Year	Commercial	Non Commercial			Total
		Domestic	Indian Food Fish	Combined	
1960	4,058		5,595	5,595	9,653
1961	3,446		9,800	9,800	13,246
1962	4,037		9,900	9,900	13,937
1963	2,283		7,794	7,794	10,077
1964	3,208		4,200	4,200	7,408
1965	2,265		3,115	3,115	5,380
1966	1,942		2,510	2,510	4,452
1967	2,187		2,963	2,963	5,150
1968	2,212		2,830	2,830	5,042
1969	1,640		984	984	2,624
1970	2,611		2,052	2,052	4,663
1971	3,178		3,269	3,269	6,447
1972	1,769		3,960	3,960	5,729
1973	2,199		2,323	2,323	4,522
1974	1,808	406	3,417	3,823	5,631
1975	3,000	400	2,600	3,000	6,000
1976	3,500	500	1,025	1,525	5,025
1977	4,720	531	2,276	2,807	7,527
1978	2,975	421	2,485	2,906	5,881
1979	6,175	1,200	3,000	4,200	10,375
1980	9,500	3,500	9,546	13,046	22,546
1981	8,593	237	8,979	9,216	17,809
1982	8,640	435	7,833	8,268	16,908
1983	13,027	400	5,225	5,625	18,652
1984	9,885 12,474	260	6,350	6,610	16,495
Average					
1960-64	3,406	--	7,458	7,458	10,864
1965-69	2,049	--	2,480	2,480	4,530
1970-74	2,313	--	3,004	3,085	5,398
1975-79	4,074	610	2,277	2,888	6,962
1980-84	9,929	966	7,587	8,553	18,482

a/ Catch in numbers of fish.

ppendix Table 5. Alaskan catch of Yukon River chum salmon, 1961-1984.

Year	Summer Chum			Fall Chum			Total Chum		
	Subsistence b/	Commercial	Total	Subsistence b/	Commercial	Total	Subsistence b/	Commercial	Total
1961	305,317		305,317	101,772	42,461	144,233	407,089	42,461	449,550
1962	261,856		261,856	87,285	53,116	140,401	349,141	53,116	402,257
1963	297,094		297,094	99,031		99,031	396,125	0	396,125
1964	361,080		361,080	120,360	8,347	128,707	481,440	8,347	489,787
1965	336,848		336,848	112,283	23,317	135,600	449,131	23,317	472,448
1966	154,508		154,508	51,503	71,045	122,548	206,011	71,045	277,056
1967	206,233	10,935	217,168	68,744	38,274	107,018	274,977	49,209	324,186
1968	133,880	14,450	148,330	44,627	52,925	97,552	178,507	67,375	245,882
1969	156,191	61,966	218,157	52,063	131,310	183,373	208,254	193,276	401,530
1970	166,504	137,006	303,510	55,501	209,595	265,096	222,005	346,601	568,606
1971	171,487	100,090	271,577	57,162	189,594	246,756	228,649	289,684	518,333
1972	107,961	135,668	243,629	35,987	152,176	188,163	143,948	287,844	431,792
1973	159,253	285,509	444,762	53,084	232,090	285,174	212,337	517,599	729,936
1974	182,678	589,892	772,570	101,424	289,776	391,200	284,102	879,668	1,163,770
1975	168,875	710,295	879,170	93,761	275,009	368,770	262,636	985,304	1,247,940
1976	140,276	600,894	741,170	77,883	156,390	234,273	218,159	757,284	975,443
1977	159,502	534,875	694,377	82,171	257,986	340,157	241,673	792,861	1,034,534
1978	197,137	1,052,226	1,249,363	94,867	236,383	331,250	292,004	1,288,609	1,580,613
1979	196,187	779,316	975,503	233,347	359,946	593,293	429,534	1,139,262	1,568,796
1980	272,398	928,609	1,201,007	172,657	293,430	466,087	445,055	1,222,039	1,667,094
1981	208,284	1,006,938	1,215,222	188,525	466,451	654,976	396,809	1,473,389	1,870,198
1982	136,356	461,424	597,780	132,897	224,187	357,084	269,253	685,611	954,864
1983	240,386	774,879	1,015,265	192,930	302,598	495,528	433,316	1,077,477	1,510,793
1984	230,565	588,597	819,162	174,664	208,232	382,896	405,229	796,829	1,202,058
Average									
1961-64	306,337	—	306,337	102,112	34,641	128,093	408,449	25,981	434,430
1965-69	197,532	29,117	215,002	65,844	63,374	129,218	263,376	80,844	344,220
1970-74	157,577	249,633	407,210	60,632	214,646	275,278	218,208	464,279	682,487
1975-79	172,395	735,521	907,917	116,406	257,143	373,549	288,801	992,664	1,281,465
1980-84	217,598	752,089	969,687	172,335	298,980	471,314	389,932	1,051,069	1,441,001

a Catch in numbers of fish.

b Includes small numbers of pink and chum salmon during the period 1961-1976.

Appendix Table 6. Canadian catch of Yukon River chum salmon (including Porcupine River), 1960-1984. a/

Year	Commercial	Non Commercial			Total
		Domestic	Indian Food Fish	Combined	
1960	5,493		10,115	10,115	15,608
1961	3,276		5,800	5,800	9,076
1962	936		8,500	8,500	9,436
1963	2,196		25,500	25,500	27,696
1964	1,929		10,258	10,258	12,187
1965	2,071		9,718	9,718	11,789
1966	3,157		10,035	10,035	13,192
1967	3,343		13618	13,618	16,961
1968	453		11,180	11,180	11,633
1969	2,279		5,497	5,497	7,776
1970	2,479		1,232	1,232	3,711
1971	1,761		15,150	15,150	16,911
1972	2,532		5,000	5,000	7,532
1973	2,806		7,329	7,329	10,135
1974	2,544	466	8,636	9,102	11,646
1975	2,500	4,600	13,500	18,100	20,600
1976	1,000	1,000	3,200	4,200	5,200
1977	3,990	1,499	6,990	8,489	12,479
1978	3,356	728	5,482	6,210	9,566
1979	9,084	2,000	11,000	13,000	22,084
1980	9,000	4,000	9,218	13,218	22,218
1981	15,260	1,611	5,410	7,021	22,281
1982	11,312	683	4,096	4,779	16,091
1983	25,990	300	3,200	3,500	29,490
1984	22,932	535	5,800	6,335	29,267
11	25,241			5,519	41,225
Average					
1960-64	2,766	--	12,035	12,035	14,801
1965-69	2,261	--	10,010	10,010	12,270
1970-74	2,424	--	7,469	7,563	9,987
1975-79	3,986	1,965	8,034	10,000	13,986
1980-84	16,899	1,426	5,545	6,971	23,869

a Catch in numbers of fish.

Appendix Table 7. Chinook salmon escapement indices for selected spawning areas in the Yukon River drainage, 1974-1984. a

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
W.F. Andreafsky River	285	301	643	1,499	1,062	1,134	1,500	231 b	851	-	1,993
E.F. Andreafsky River	-	993	818	2,008	2,487	1,180	958 b	2,146	1,274	-	1,573 b
Anvik River	471 c	730 d	1,154 d	1,371 d	1,324 d	1,484 d	1,330	807 b	-	653 b	641 b
Nulato River	78	204	648	487	920	1,507	1,323	791 b	-	1,006	-
Chena River	1,035 e	316 e	531	563	1,726	1,159	2,541	600 b	2,073	2,553	501
Salcha River	1,857	1,055	1,641	1,202	3,499	4,789	6,757	1,237 b	2,534	1,961	1,031
Big Salmon River	70 b	153 b	86 b	316 b	524	632	1,568	2,411	757	540	1,044
Nisutlin River	150 b	363 b	152 b	77 b	484 b	896 b	1,852	2,189	779	903	1,178
Whitehorse Fishway	273	313	121	277	725	1,184	1,383	1,539	473	905	977 f

a Data obtained by aerial survey unless otherwise indicated. Only peak estimates are listed.

b Incomplete or poor survey conditions resulted in a minimal or inaccurate count.

c Tower count. A minimal estimate due to poor water visibility.

d Sum of tower count and aerial or boat survey below tower site.

e Boat survey.

f An additional 65 chinook salmon were taken for artificial spawning.

Appendix Table 8. Summer chum salmon escapement indices for selected spawning areas in the Yukon River drainage, 1974-1984. a

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
W.F. Andreafsky River	33,578	235,954	118,420	63,120	57,321	43,391	115,457	-	7,267 b	-	238,565
E.F. Andreafsky River	3,215 b	223,485	105,347	112,722	127,050	66,471	36,823 b	81,555	7,501 b	-	95,200 b
Sonar Estimate	-	-	-	-	-	-	-	147,312	181,352	110,608	70,125
Anvik River	201,277 c	845,485 d	406,166 d	262,854 d	251,339 d	107,520 b	337,590 b	524,685 b	-	-	-
Sonar Estimate	-	-	-	-	-	280,537	492,676	1,479,582	444,581	362,912	891,028
Nulato River	51,160	138,495	40,001 b	69,660	54,480	37,104	14,946 b	-	-	21,012	-
Hogatza River	-	22,355	20,744	10,734	5,102	14,221	19,786	-	4,984	28,141	-
Salcha River	3,510	7,573	6,474	677	5,405	3,060	4,140	8,500	3,756	716	9,810

a Data obtained by aerial survey unless otherwise indicated. Only peak estimates are listed.

b Incomplete or poor survey conditions resulted in a minimal or inaccurate count.

c Tower count.

d Sum of tower count and aerial survey below tower site.

Appendix Table 9. Fall chum salmon escapement indices for selected spawning areas in the Yukon River drainage, 1973-1984. a

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Sheenjek River	1,175 b	40,507	78,060	11,866	20,506	14,610 b	41,140	13,027	12,625 b	-	22,230	11,402
Sonar Estimate	-	-	-	-	-	-	-	-	69,043	29,093	45,733	25,120
Fishing Branch River	-	-	78,615	13,450	32,500	15,000	44,080	20,319 b	10,549 b	5,846	10,000	5,570
Weir Estimate	15,987	32,525	353,282	-	-	-	-	-	-	-	-	-
Upper Toklat River	6,957	34,310	42,418 b	35,190	21,800 b	35,000	96,550	23,054	13,907	3,309 c	15,105 c	15,861 c
Delta River	7,971	4,010	3,089 c	5,498	17,925	10,051	8,125	4,637	22,375 c	3,433 c	7,230 c	12,327 c

a Data obtained by aerial survey unless otherwise indicated. Only peak estimates are listed.

b Incomplete or poor survey conditions resulted in a minimal or inaccurate count.

c Foot Survey.